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90-DAY INHALATION TOXICITY STUDY OF BIO-DERIVED GEVO ALCOHOL-TO-JET (ATJ) SYNTHETIC PARAFFINIC KEROSENE (SPK) IN RATS WITH NEUROTOXICITY TESTING AND GENOTOXICITY ASSAY

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14. ABSTRACT Several alternative fuel types have been certified or are undergoing certification by the U.S. Air Force (USAF), including alcohol-to-jet (ATJ) synthetic paraffinic kerosene (SPK) fuels. An ATJ SPK fuel from biological feedstocks developed by Gevo of Englewood CO (Gevo ATJ SPK (bio)) was used in a 90-day inhalation study with male and female Fischer 344 rats (10 rats per sex per exposure concentration). Rats were exposed to 0, 200, 700, or 2000 mg/m ³ fuel in an aerosol/vapor mixture for 6 hours per day, five days per week for 70 total exposure days. No changes were seen in body weights, food consumption, and reproductive indices (vaginal cytology, sperm cell parameters). Neurobehavioral effects, evaluated by motor activity and functional observational battery (FOB) assays, were found limited to two minor changes in 2000 mg/m ³ exposure group female rats (moderately higher total activity time over 60 minutes and urine stains noted during the FOB, indicating grooming changes). Mild to moderate histopathological changes were primarily found in the nasal cavity of the 2000 mg/m ³ exposure group rats. In a blood reticulocyte micronucleus assay, Gevo ATJ SPK (bio) was not shown to be clastogenic. Overall, the 90-day study with Gevo (bio) ATJ SPK indicates that inhalation of Gevo (bio) fuel, alone or combined as a 50:50 blend with petroleum-derived JP-8, is unlikely to increase human health risks in the military workplace.							
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PREFACE

Funding for this project was provided through the former Alternative Fuels Certification Office (AFLCMC/WNN). This research was conducted under contract FA8650-10-2-6062 with the Henry M. Jackson Foundation for the Advancement of Military Medicine (HJF) or under Navy work unit number H1104 under the management of Naval Medical Research Unit – Dayton (NAMRU-D). The program manager for the HJF contract was David R. Mattie, PhD (711 HPW/RHDJ), who was also the technical manager for this project. The technical manager for NAMRU-D was Karen L. Mumy, PhD.

The 90-day study protocol was designed to be in compliance with the U.S. Environmental Protection Agency (U.S. EPA) Office of Prevention, Pesticides and Toxic Substances (OPPTS) Guideline 870.3465: 90-Day Inhalation Toxicity (1998) and the Organisation for Economic Co-operation and Development (OECD) Guidelines for Testing of Chemicals, Section 413, Subchronic Inhalation Toxicity: 90-day Study (OECD, 2009). The neurotoxicity portion of the study follows OPPTS 870.6200 Neurotoxicity Screening Battery (U.S. EPA, 1996a) and the genotoxicity portion follows OPPTS 870.5395 Mammalian Erythrocyte Micronucleus Test (U.S. EPA, 1996b).

This study was not performed in a Good Laboratory Practice (GLP) Standards certified laboratory, and therefore there is no certification of compliance with GLP regulations (40 CFR Part 792). However, this study was conducted with an effort to follow the intent and purpose of GLP requirements.

The 90-day study with Neurotoxicity Testing and Genotoxicity Assay was approved by the Wright-Patterson Air Force Base (AFB) Installation Animal Care and Use Committee (IACUC) as protocol number F-WA-2013-0144-A. The study was conducted in a facility accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care (AAALAC), International, in accordance with the Guide for the Care and Use of Laboratory Animals (NRC, 2011). The study was performed in compliance with DODI 3216.1.

The authors would like to acknowledge LTC Karyn Armstrong and the Vivarium staff of the U.S. Air Force 711 Human Performance Wing (711 HPW/RHDV), who provided the daily efforts necessary for animal husbandry and animal observations.

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1.0 SUMMARY

Several alternative fuel types have been certified or are undergoing certification by the U.S. Air Force (USAF), including those produced through a process called alcohol-to-jet (ATJ). ATJ synthetic paraffinic kerosene (SPK) fuels are produced by the oligomerisation of short-chained alcohol feedstocks into 12 to 16 carbon chain alkanes. Renewable feedstock sources consist of fermented sugars or lignocellulosic biomass. The USAF is investigating ATJ SPK fuels for use in a 50:50 blend with petroleum-derived JP-8. An ATJ SPK fuel from biological feedstocks developed by Gevo of Englewood CO was used in a 90-day inhalation study with male and female Fischer 344 rats (10 rats per sex per concentration). Rats were exposed to 0, 200, 700, or 2000 mg/m³ Gevo ATJ SPK (bio) fuel in an aerosol/vapor mixture for 6 hours per day, five days per week for 69 exposure days.

Average (\pm standard deviation (SD)) measured fuel concentrations were -0.13 ± 0.15 , 200.6 ± 2.3 , 705.6 ± 13.7 , and 2001.8 ± 29.5 mg/m³ (aerosol + vapor) and average aerosol concentrations (\pm SD) were 1.22 ± 1.36 , 1.74 ± 1.4 , 3.54 ± 0.76 , and 46.6 ± 5.5 mg/m³, respectively. Body weights and food consumption did not differ between exposure groups throughout the study. As an indicator of reproductive health, vaginal cytology was assessed during week 9 of exposure, and sperm count, motility, and morphology were evaluated after the full 69 days of exposure; no abnormalities were found for males or females across the exposure groups. During week 13 and 14 motor activity assays and the functional observational battery (FOB) were performed to assess potential neurobehavioral effects. Exposed male rats exhibit different behaviours compared to control males; however, female rats in the 2000 mg/m³ exposure group displayed two minor neurobehavioral changes: moderately higher total activity time over 60 minutes and urine stains noted during the FOB, indicating degraded grooming activity.

Following the final exposure, rats were euthanized in accordance with American Veterinary Medical Association (AVMA) 2013 guidelines. No exposure-related differences were observed in hematology or clinical pathology endpoints. Histopathological changes were primarily in the nasal cavity. Mild to moderate irritation-related lesions in the nasal respiratory epithelium occurred in both males and females among the 2000 mg/m³ exposure group. Minimal severity lesions in the olfactory epithelium of the nasal cavity occurred with low frequency among the 700 mg/m³ (aerosol/vapor) exposed rats; these lesions did not appear to exceed background (control) incidence. Mild to moderate intensity lesions were found with increased frequency only among the 2000 mg/m³ exposure group, as was minimal to mild goblet cell hyperplasia. Female rats exhibited more nasal lesions than male rats across both types of epithelium. Inflammatory infiltrates were observed in the lungs, likely due to focal deficits in clearance; infiltrates were increased in number and severity in the high exposure group due to known irritation of fuel exposure. Early stage chronic progressive glomerulonephropathy (CPG) was observed in all rats and is an age-related disease common in F344 rats; however, the severity of findings increased with increased fuel exposure in male rats due to hydrocarbon nephropathy. Kidneys were analyzed for alpha-2-urinary (α_{2u})-globulin; overproduction of this protein in male rats produces hyaline droplets, ultimately resulting in renal tubule tumors. Predictably, α_{2u} -globulin levels increased significantly with increased fuel exposure in male rats only; this effect is typically referred to as hydrocarbon nephropathy. Increased CPG and α_{2u} -globulin is considered to be male rat specific and not pertinent to human health.

In conjunction with the 90-day study, additional rats (5 rats per sex per concentration) were exposed to 0, 200, 700 or 2000 mg/m³ Gevo ATJ SPK (bio) fuel in an aerosol/vapor mixture for 6 hours per day, five days per week for two weeks to test for genotoxicity by micronucleus formation. Bone marrow samples collected from femurs were stained and examined for reticulocytes and micronucleated reticulocytes. Bone marrow cell toxicity was not observed and a lack of increase in micronuclei across concentrations indicates that Gevo ATJ SPK (bio) is not clastogenic. Overall, the 90-day study with Gevo (bio) ATJ SPK indicates that inhalation of Gevo (bio), alone or in a 50:50 blend with petroleum-derived JP-8, is unlikely to increase human health risks in the military workplace.

2.1 INTRODUCTION

Under the FY2012 National Defense Authorization Act, fit-for-purpose testing of alternative fuels became Department of Defense (DOD) policy. Per this directive, viable alternative fuels must require no equipment modification, be cost-competitive, be available in a useful quantity, be produced from non-food crops, and result in emissions comparable to or lesser than petroleum-derived fuels. Per the Act, the U.S. Air Force (USAF) set the goal of being able to fly and/or drive on 50:50 petroleum:alternative blends by 2016 (Blakeley, 2012).

Several alternative fuel types have been certified or are undergoing certification by the USAF, including those produced through a process called alcohol-to-jet (ATJ). ATJ synthetic paraffinic kerosene (SPK) fuels are produced by the oligomerisation of short-chained alcohol feedstocks into 12 to 16 carbon chain alkanes (Milbrandt *et al.*, 2013). Renewable feedstock sources consist of fermented sugars or lignocellulosic biomass (Satyarthi *et al.*, 2013). The U.S. Air Force is investigating ATJ SPK fuels for use in a 50:50 blend with the petroleum-derived jet propulsion fuel JP-8.

Each alternative fuel's composition is different from JP-8 and each other; therefore, potential toxicity from exposure to each fuel must be considered. The ATJ SPK tested for inhalation toxicity in this report was produced by Gevo (Englewood CO). This fuel, known as Gevo ATJ SPK (bio), was produced from a biologically derived isobutanol feedstock. The Gevo proprietary process utilizes a yeast biocatalyst to ferment sugars from a mixed biological source feedstock into isobutanol. Biological sources for the Gevo feedstock currently include grains (corn, wheat, sorghum, barley, etc.) and sugarcane but will be expanded to cellulosic feedstocks (switchgrass, waste wood, corn cob/stalk pulp, sugarcane waste) (Gevo, 2011). Abbreviated to Gevo (bio), this fuel is also identified in the USAF by log book numbers POSF 9641 (alone) and POSF 10021 when mixed with the USAF-required standard JP-8 additive package; the exposure testing was performed with POSF 10021. The POSF log book numbers are provided by the Air Force Research Laboratory Fuels and Energy Branch (AFRL/RQTF) located at Wright-Patterson Air Force Base (AFB) OH, formerly known as the Air Force Wright Aeronautical Laboratories (AFWAL/POSF). Use of the commercial name and product does not constitute endorsement by the USAF.

2.2 Objective

The objective of this study was to assess the potential inhalation toxicity of the Gevo ATJ SPK (bio) fuel in Fischer 344 rats. To this end, whole body inhalation exposures were conducted 6 hours/day, 5 days/week over a 90-day period, at concentrations of 0 (control), 200, 700, or 2000 mg/m³ Gevo (bio) (POSF 10021). Groups of 10 males and 10 females were exposed at each exposure concentration for a total of 40 males and 40 females. Additional endpoints assessed were neurotoxicity, reproductive toxicity, and genotoxicity.

3.1 METHODS

This study was designed to assess the potential toxicity of Gevo ATJ SPK (bio) fuel when administered as an aerosol and vapor inhalation exposure to rats for 6 hours per day, 5 days per week over approximately 90 days, at concentrations of 0, 200, 700, and 2000 mg/m³. Each exposure group consisted of ten male and ten female Fischer 344 rats; each exposure group had two replicates of five males and five females each (Table 1). The replicates were staggered by one day in the exposure schedule to accommodate necropsy at the end of exposures.

Additionally, exposures accommodated holidays and the neurobehavioral testing schedule, which resulted in a total of 100 days from first exposure to last necropsy, with each replicate receiving 69 exposures. The study followed the U.S. Environmental Protection Agency (U.S. EPA) Office of Prevention, Pesticides, and Toxic Substances (OPPTS) Guideline 870.3465: 90-Day Inhalation Toxicity (1998) and the Organisation for Economic Co-operation and Development (OECD) Guidelines for Testing of Chemicals, Section 413, Subchronic Inhalation Toxicity: 90-day Study (OECD, 2009).

Table 1. 90-day Study Design

Group	Exposure Level mg/m ³	Number of Animals	
		Males	Females
Control Replicate 1	0	5	5
Control Replicate 2		5	5
Low Replicate 1	200	5	5
Low Replicate 2		5	5
Intermediate Replicate 1	700	5	5
Intermediate Replicate 2		5	5
High Replicate 1	2000	5	5
High Replicate 2		5	5
Total		40	40

Additionally, to assess the genotoxic potential of the fuel (see Section 3.13 Micronucleus Assay below), five males and five female F344 rats per exposure concentration were exposed for two weeks (10 days of exposure) to the Gevo (bio) fuel, concurrent with the first two weeks of the 90-day exposure. Positive (cyclophosphamide) and negative (saline) control groups were assessed in the assay; control groups consisted of five male and five female rats in each group (Table 2). The complete animal study protocol for all of these methods can be found in Appendix A.

Table 2. Micronucleus Study Design

Group	Exposure Level mg/m ³	Number of Animals	
		Males	Females
Control	0	5	5
Low	200	5	5
Intermediate	700	5	5
High	2000	5	5
Negative Control	saline	5	5
Positive Control	cyclophosphamide	5	5
Total		30	30

3.2 Test Substance

The Gevo ATJ SPK (bio) jet fuel (Gevo, Englewood CO) was supplied by the Air Force Research Laboratory Fuels and Energy Branch (AFRL/RQTF) at Wright Patterson AFB OH. An additive package consisting of chemicals normally added to JP-8 jet fuel was mixed per USAF requirement with the ATJ SPK fuel at the Fuels and Energy Branch facility; additives comprise less than 0.15 percent by weight. The combination of Gevo (bio) fuel with additives was designated as POSF log book number 10021 by the Fuels and Energy Branch. Records regarding the receipt of the base ATJ SPK fuel and additive package and the POSF log book are maintained by the Fuels and Energy Branch. The fuel was stored under room temperature ambient conditions in a flame resistant cabinet.

Purity and stability data are maintained by the Fuels and Energy Branch. Table 3 summarizes the composition of Gevo (bio) fuel versus JP-8, as analyzed by comprehensive two-dimensional gas chromatography (GC x GC). The GC x GC method is detailed in Striebich *et al.* (2014).

Table 3. Summary Comprehensive Two-Dimensional Gas Chromatography Component Comparison of Test Substances

Fuel	JP-8	Gevo ATJ SPK (bio)
POSF log book number*	4658	9641
AROMATICS		
Total Alkylbenzenes	13.69	<0.01
Total Alkyl-naphthalenes	1.76	<0.01
Total Cycloaromatics	5.79	<0.01
Total Aromatics	21.24	0.01
ALIPHATICS		
Total iso-Paraffins	31.34	99.43
Total n-Paraffins	19.00	0.02
Total Cycloparaffins	28.42	0.54
Total Aliphatics	78.76	99.99
TOTAL	100.00	100.00

Note: Component values given in mass percent. *Component analysis was performed on the fuel (POSF 9641) prior to the addition of additives.

3.3 Animals and Animal Husbandry

Animals were ordered from Charles River Laboratories (Kingston NY). The rats immediately entered a quarantine and acclimation period for 10 days. During this period, each animal was observed twice daily for mortality, morbidity and changes in general appearance or behavior. Animals were same sex paired and housed in plastic, solid bottom cages.

During the week prior to start of exposures, the rats were acclimated to the stainless steel wire-mesh cages (R-16 cage units, Lab Products, Inc., Seaford DE) by placing them individually into the cages for an increasing length of time (1, 2, 3, 4, and 6 hours) on successive days.

After random assignment to study groups, rats were housed individually to prevent ingestion of the jet fuel through peer grooming and to monitor food consumption. Control group rats were housed in a separate animal room from the exposed rats, to avoid exposure to any fuel that might off-gas from the fur of the exposed rats. Tail tattoos were used to identify individual animals; a unique number was assigned to each animal by the Vivarium staff.

Animal housing room conditions were maintained at approximately 22 °C and 50 percent humidity, with a 12 hour light/dark cycle. Animals were fed a certified rodent diet (Formulab Diet Purina Lab Chow, PMI Nutrition, International, LLC, Brentwood MO), *ad libitum*, except during cage acclimation, exposure, and neurobehavioral testing outside the home cage. Rats

were fasted the night prior to euthanasia and necropsy. Reverse osmosis purified municipal tap water was available at all times, including exposure, except during neurobehavioral assessments outside the home cage.

Rats were weighed the day after arrival and at randomization. Body weights were measured prior to each exposure session. Following randomization, individual feed container weights were weighed to provide food consumption measurements.

3.4 Exposure System

Rats were exposed via inhalation in 1-cubic meter stainless steel and glass whole body exposure chambers (H1000, Lab Products, Inc., Seaford DE). Four chambers were utilized, one for each exposure group. Each chamber was equipped to hold three stainless steel wire mesh cages, each of which holds 16 rats in individual compartments (R-16, Lab Products, Inc., Seaford DE). Each animal was contained individually in wire mesh cages to allow free flow of the test atmosphere and to prevent huddling together, which can reduce or filter exposure.

Air from the room was passed through a 95 percent high efficiency particulate air (HEPA) filter and distributed by a blower to the exposure chambers. The chambers were operated at a flow rate of approximately 225 L/min to provide at least one complete air change in 4.45 minutes; this rate was calculated to provide 13.5 air changes per hour, which exceeds the minimum guideline requirement of 10 air changes per hour, and a minimum of 19 percent oxygen.

Inlet air flows were controlled by a manually operated gate valve. Air flow was measured at the inlet to each chamber using a mass flow monitor (Model HFM-200 LFE, Teledyne-Hastings Instruments, Pittsburgh PA) connected to a laminar flow element (Model HFM-200 LFE, Teledyne-Hastings Instruments). Each of the mass flow monitors were connected to a four-channel power supply (Model THPS-400-115, Teledyne-Hastings Instruments). The T_{99} equilibrium time was calculated to be approximately 20.5 minutes; T_{99} is the time for the concentration of test substance in the chamber to rise from background (zero) to 99 percent of the target concentration. The exposure period (6 hours) started when the compressed air and the fuel flow were applied to the nozzle.

Following exposure, chamber air flow was switched to clean room air. Animals remained in their respective chambers for 20 to 30 minutes, in order to clear most of the fuel from the chamber. Rats in the control exposure group were removed from the chamber first and transferred to home cages in their separate animal housing room prior to the removal of any exposed rats.

Temperature and relative humidity were measured by a temperature/relative humidity probe (Model HF532WB6XD1XX, Model HC2-S, Rotronics Instruments, Inc., Hauppauge NY) located inside each exposure chamber. The target temperature was between 20 and 24° C (68 and 75° F) and the target relative humidity was between 30 and 70 percent.

3.5 Generation System

Mixed aerosol and vapor jet fuel exposure atmospheres were generated by pumping the liquid jet fuel into an air atomizing nozzle (Model SUJ1A with fluid cap 1650 and air cap 64, Spraying Systems Co., Wheaton IL). A liquid metering pump (Fluid Metering, Inc., Syosset NY) moved liquid jet fuel from a glass bottle reservoir to the nozzle. Compressed instrument air at approximately 35 psi was supplied to the nozzle. The spray was directed into a custom-made stainless steel mixing volume and then injected into the inlet air stream to the exposure chamber.

3.6 Fuel Concentration Measurements

Monitoring of the jet fuel concentration was provided through Fourier transform infrared (FTIR) spectrophotometers (Model iS10, Thermo Scientific, Waltham MA) connected to each chamber. The signal output from each sample of chamber atmosphere was then recorded digitally via a computer. FTIRs with serial numbers AKX1300144, AKX1300156, AKX1300161, and AKX1300146 were connected to the 0, 200, 700, and 2000 mg/m³ exposure chambers, respectively.

3.6.1 FTIR Calibration. The FTIR was calibrated using a closed loop system. Four FTIRs, two with short path (2 meters) and two with long path (10 meters) gas cells, were arranged in series with a metal bellows pump (MB-41, Metal Bellows, Sharon MA), a filter unit, and a 10 gallon, stainless steel pressure vessel (Part No. 41665K32, McMaster-Carr, Aurora OH), which provided more total volume to the system. The total volume of the system was determined using the method described elsewhere (Reboulet *et al.*, 2009). Known weights of jet fuel were injected into the system just prior to a filter unit, and allowed to re-circulate until equilibrium was established between the volatile components and the non-volatile components at room temperature. Replicate, additive injections were made over a series of concentrations.

FTIR absorption measurements were recorded approximately every 20 seconds until the maximum absorption reading was reached and maintained for several minutes. Each recording was saved as a line in a text file, which was subsequently imported into Excel for plotting. A calibration curve of spectrophotometer response as a function of jet fuel concentration in milligrams per meter cubed (mg/m³) was produced for each instrument, and the regression values were input into the macro program on each respective computer.

Nominal concentrations for each chamber were calculated from the air flow rate through the chamber, the total generation time, and the mass of fuel consumed during the exposure. The reservoirs containing the jet fuel used by the generation system were weighed at the start of generation and after the exposure period using an analytical balance (Adventurer Pro, OHAUS, Parsippany NJ). A flow rate 225 L/minute and exposure time of 360 minutes were used in the calculation.

3.6.2 Chamber Distribution. A custom door was constructed with nine sampling ports for the H1000 chamber. To check the uniformity of distribution, the ports were equipped with sampling lines extending to each corner as well as to the center of the chamber. All exposure cages and waste collection pans were in place during the chamber distribution test. The aerosol/vapor exposure generation system was operated to achieve the approximate target concentration. Five minute samples were taken from the center port, then three alternate ports, and again from the center port. Next, three alternate ports were sampled, then the center port, followed by two more alternate ports, and finally the center port again.

3.6.3 Aerosol Characterization. Aerosol mass concentration was measured weekly using gravimetric filters. Particle size distribution measurements were performed using a cascade impactor (7-stage, In-Tox Products, Moriarity NM). Particle size was measured approximately once weekly. Particle size was also monitored by an Aerodynamic Particle Sizer (APS) (Model 3321, TSI, Inc., Shoreview, MN).

3.7 Ophthalmologic Exam

Animals were given an ophthalmological exam to look for eye defects prior to the study. An ophthalmoscope was used in addition to a gross observation of the eyes. Following the study, all animals from the control and 2000 mg/m³ groups were examined again. All rats were to be examined if changes were found between the control group and the high exposure group animals. These endpoints are intended to identify unusual or abnormal behavior that may indicate potential neurotoxic effects caused by the inhalation of Gevo (bio) fuel.

3.8 Neurobehavioral Assessments

Neurobehavioral assessment is required by the 90-day study guidelines (U.S. EPA, 1998) and is described in detail in OPPTS Guideline 870.6200: Neurotoxicity Screening Battery (U.S. EPA, 1996a).

3.8.1 Motor Activity. Motor activity (gross locomotor movements and exploratory behavior) were evaluated during the 13th week of exposure. Animals were individually placed in clear plastic open fields measuring 16 x 16 x 15 inches (width x depth x height, respectively) with horizontal and vertical photobeam frames. The photocells were mounted one-inch apart in frames placed at ground level to detect horizontal movement and in an elevated frame to detect vertical rears; elevated sensors also allow differentiation of small (stereotypic) movements from large movements.

Each individual animal was placed in the center of the open field and left uninterrupted for the duration of a one-hour test session. Beam breaks were automatically recorded using a photobeam activity system and software from San Diego Instruments (San Diego CA). The following dependent measures were automatically recorded: distance traveled (cm), time spent

active/ time spent resting (seconds), average speed (cm/second), number of fine beam breaks (stereotypical), total number of rears, percentage of time in center versus perimeter, and total activity habituation over six 10-minute blocks.

Motor activity was measured in a room with white noise generated at 73 dB to mask/equalize ambient room levels of approximately 70 dB. Low illuminating light was standardized at 30 lux. Neither food nor water was provided during behavioral observations. Between each test, the open fields were washed with a solution of 10 percent ethanol to remove olfactory cues from the previous occupants.

3.8.2 Functional Observational Battery. A functional observational battery (FOB) evaluates signs of toxicity to the nervous system that may result in gross behavioral changes and functional deficits. FOB evaluations were performed in the 14th week, during a day off from exposure in which the prior three or more consecutive days were exposure days. Animals from the first replicate of each exposure group were evaluated in the neurotoxicology observation room on the same day; the second replicate from each exposure group was tested the following day.

The FOB consists of non-invasive procedures designed to evaluate and document the absence or presence (with severity, if appropriate) of a predetermined set of behavioral and clinical signs. The first observations were made with the rat in its home cage; assessments included posture, tremors and spasms, and palpebral closure. The second set of observations were made during the removal of the rat from the cage and subsequent holding, including the rat's reactivity to handling, muscle tone, lacrimation, salivation, fur appearance including facial crust, breathing pattern, and any other clinically abnormal signs presented. Third, open field observations included arousal and general activity level, gait, body position, vocalization, tremor, spasm, unusual behaviors, and urination and defecation counts. Finally, minimally manipulative tests were performed, including:

- approach response: response to a blunt object approaching and stopping before the animal's nose,
- acoustic response: response to a hidden metallic click,
- tail pinch response: response to a pinch of the tail,
- visual placement: response of forelimb to grasp for a surface while being held by the observer,
- surface righting: righting response to being turned and briefly held on its back,
- hind leg splay: response to being dropped approximately 30 cm (12 inches). Hind legs were painted to mark the location of the hind legs upon landing,
- grip strength: force necessary to break the animal's grip on a wire mesh, and
- pupillary light reflex: pupil response to light.

Hind leg splay was not performed if the animal was judged too weak to support its weight when dropped or if the righting response was not displayed. FOB was performed in a room with white noise generated at 73 dB to mask/equalize ambient room levels of approximately 70 dB. Low illuminating light was standardized at 30 lux. Efforts were made to further control conditions such as temperature, humidity, odors, time of day, and environmental distractions, to avoid

affecting behavior. Rats were assigned a temporary identification number using cage cards in order to keep FOB observers blind to the treatment group. Neither food nor water was provided during behavioral observations conducted outside the home cage.

3.8 Vaginal Cytology

Vaginal cytology was conducted on all female rats during the 9th and 10th week of exposure. A vaginal lavage was performed on each female rat daily over a seven consecutive day period. Lavage was performed prior to exposure on exposure days or at approximately the same time on non-exposure days. Approximately 25 µL of physiological saline was gently flushed into the vaginal opening and aspirated back into a pipette tip. The aspirate was placed on a glass slide, the slide prepared, and then read using light microscopy.

The rat estrous cycle lasts approximately four to five days; its stages are characterized as proestrus, estrus, metestrus, and diestrus. Proestrus is indicated by a predominance of nucleated round epithelial cells in a vaginal lavage sample. Estrus is indicated by a predominance of irregularly shaped cornified epithelial cells in which the nucleus is not well-defined or is absent. Metestrus is indicated by an approximately equal distribution of leukocytes, cornified epithelial cells and nucleated round epithelial cells. Diestrus is indicated by a predominance of leukocytes.

3.9 Sperm Motility and Concentration

Immediately following the last exposure, animals were euthanized in accordance with current American Veterinary Medical Association (AVMA) guidelines (AVMA, 2013). Following euthanasia of male rats, the right epididymis was dissected and weighed. The cauda was then removed and submitted for sperm motility/morphology analyses. The right testes were frozen for count analysis. The left epididymis and testes were dissected and preserved in Bouin's solution for histopathology.

To determine sperm motility, the right cauda was placed in a petri dish containing M-199 media with Hank's Balanced Salts (catalog number 12350-039, Life Technologies, Carlsbad CA). The cauda was then punctured and the sperm allowed to diffuse from the tissue for approximately 1 minute. If needed, the sample of the sperm was diluted with additional M-199 media. An aliquot was analyzed for sperm motility using computer assisted sperm analysis (CASA) via proprietary software (IVOS, Hamilton Thorne, Inc., Beverly MA). Data were reported as the fraction of motile sperm. From the petri dish, an aliquot was stored in 10 percent formalin, refrigerated, and used for later morphology analysis.

Testicular spermatid head counts were evaluated from the frozen right testes. The right testes were thawed and reweighed prior to homogenizing for sperm counts. Those samples were homogenized in buffer solution and analyzed on the IVOS sperm analyzer.

3.10 Necropsy

During euthanasia, terminal blood was collected via the caudal vena cava for hematology and clinical chemistry. For males, the right testicle and cauda epididymis were taken for sperm analysis, and the body necropsied for the remaining tissues. The necropsy included examination of the external surface and all orifices; the organs and tissues of the cranial, thoracic, abdominal and pelvic cavities and neck; and the remainder of the carcass. Pathology observations were conducted by a board certified veterinary pathologist. Wet weights of the liver, kidneys, adrenals, testes, epididymides, ovaries, uterus, thymus, spleen, brain, and heart were obtained after dissection from the exposure and control animals.

3.11 Clinical Chemistry and Hematology

Terminal blood samples were analyzed for clinical chemistry and hematology endpoints. Prothrombin time in plasma (PT-P) and international normalized ratio (INR) were determined using a blood clot analyzer (GEM PCL Plus, Instrumentation Laboratory, Lexington MA). Samples of whole blood with anticoagulant were examined using a blood analyzer (Hemavet 950, Drew Scientific, Dallas TX), while samples of serum were assessed using a chemistry analyzer (Vet Test 8008 and Vet Lyte, IDEXX Laboratories, Westbrook ME).

3.12 Measurement of α_{2u} Globulin Protein

Kidneys from male and female rats were utilized to quantify the amount of alpha-2-urinary (α_{2u})-globulin protein in kidney tissue. One-half of each kidney (left cut longitudinally, right cut transversely) was flash frozen and stored at -80 °C until analysis of the kidney homogenate with an enzyme-linked immunosorbent assay (ELISA) procedure.

3.13 Micronucleus Genotoxicity Assay

To assess the genotoxic potential of the fuel, five males and five female F344 rats per exposure concentration (see Table 2 above) were exposed for two weeks (ten exposures) to the Gevo (bio) fuel (concurrent with the experiment described above). An added set of rats (5 males and 5 females, not exposed to jet fuel) served as positive controls for micronucleus formation. A solution of cyclophosphamide (CP) in physiological saline was administered via intraperitoneal injection (40 mg/kg animal body weight) approximately 24 hours before euthanasia. To provide negative controls and determine the background frequency of micronuclei, a final set of rats were given physiological saline by intraperitoneal injection (1 ml per 100 g bodyweight), approximately 24 hours before euthanasia.

All animals for this assay were euthanized in accordance with current American Veterinary Medical Association (AVMA) guidelines (AVMA, 2013) and dissected to extract bone marrow from the femur. The bone marrow was analyzed for micronuclei by measuring the frequency of micronucleated cells by flow cytometry in approximately 20,000 reticulocytes from each animal.

The percentage of reticulocytes, micronucleated mature normochromatic erythrocytes, and micronucleated reticulocytes were measured per animal.

3.14 Statistics

Statistical differences were assessed based on calculations between exposure groups, not replicates within exposure groups. Male and female differences were calculated as well as between exposure group differences. SigmaPlot software (version 12.0, Systat Software, Inc., San Jose CA) was used for in-life data such as body weight, body weight gain, and food consumption. Post-mortem data such as hematology, coagulation, clinical chemistry, and organ weights were also evaluated.

Normality was tested using the Shapiro-Wilk test. Levene's test ($p < 0.01$) was performed to check for equal variance. Data for quantitative, continuous variables were compared for the exposure and control groups, independently for each gender, by one-way analysis of variance (ANOVA). If the ANOVA indicated statistical significance among experimental groups, the Dunnett's test was used to delineate which groups differ from the control group. The probability value of less than 0.05 was used as the critical level of significance for each statistical test.

When assumptions for parametric ANOVA were not met, Kruskal-Wallis or Wilcoxon Rank-sum nonparametric procedures were used. Additional exposure group comparisons of various test session activities were also performed. Incidence data was compared using the appropriate statistical test, generally Chi-Square test. Incidence data for selected FOB endpoints with ordered severity scores was analyzed for group differences using appropriate measures of association.

4.1 RESULTS

4.2 Exposure Conditions

4.2.1 Chamber Distribution. The chamber distribution was checked in each chamber prior to the start of exposures. The measured concentration at the standard sampling location at the center of the chamber provided an indication of the variability of concentration over time, while the measurements at the surrounding ports provided an indication of the variability of concentration due to spatial positioning. The chamber distribution test results indicate that the variability of concentration in the chamber is less than 0.7 percent. Chamber distribution measurement tables are found in Appendix B. To further minimize any effects due to variability of exposure concentration within the chamber, animals were placed in different cage locations over the course of the study.

4.2.2 Exposure Conditions. During each of the exposure days (May 28, 2013 through September 4, 2013), concentration, temperature, humidity, air flow, and static pressure readings were monitored (Appendix B). The humidity, temperature, static pressure, and air flow remained at target levels, and did not deviate outside of prescribed ranges (Table 4). The chamber temperatures were recorded every 10 seconds and 15 minute averages were calculated throughout the course of the day. The study average temperatures were 23.3 ± 0.4 , 22.6 ± 0.4 , 22.5 ± 0.4 , 22.1 ± 0.4 °C, for the 0, 200, 700, and 2000 mg/m³ chambers, respectively.

The Gevo fuel concentration was measured continuously by FTIR, and an exposure period average was recorded at the end of every exposure. The study average total concentrations were -0.13 ± 0.15 , 200.6 ± 2.3 , 705.6 ± 13.7 , and 2001.8 ± 29.5 mg/m³ for the 0, 200, 700, and 2000 mg/m³ chambers, respectively (Table 4). Nominal concentrations, based on the Gevo fuel used and the chamber air flow, were 198.0 ± 2.0 , 655.4 ± 19.2 , and 1958.6 ± 41.8 mg/m³, giving analytical to nominal concentration ratios of 1.01, 1.08, and 1.02, for the 200, 700, and 2000 mg/m³ chambers, respectively. Daily averages for overall Gevo fuel concentration and nominal concentration, and the fuel consumed during each day's exposure for the nominal concentration are presented in Appendix B.

The average aerosol mass concentrations, measured using gravimetric filters, were 1.2 ± 1.4 , 1.74 ± 1.4 , 3.54 ± 0.76 , and 46.6 ± 5.5 mg/m³ for the 0, 200, 700, and 2000 mg/m³ chambers, respectively; the aerosol fractions were measured as 0, 0.8, 0.5, and 2.0 percent of the total jet fuel concentration in the respective chambers (Table 4). In general, as the total Gevo fuel concentration increased, the fraction of the total that existed as aerosol droplets increased. The aerosol concentration measured in the control chamber (and probably the low group as well) is largely attributed to background particulates associated with the presence of animals, such as dander, that collected on the filter and are not related to the fuel.

The average mass median aerodynamic diameter and geometric standard deviation (MMAD (GSD)) of the aerosols were calculated as 2.53 (2.98), 2.29 (2.89), and 2.33 (2.23) µm for the 200, 700, and 2000 mg/m³ chambers, respectively (Table 4). In comparison, the average MMAD and GSD of the aerosols recorded by the APS were 1.24 (1.74), 1.86 (1.87), and 3.38 (1.87) µm for the 200, 700, and 2000 mg/m³ chambers, respectively. Aerosols with particle size distributions between 1 and 4 µm are generally considered as respirable by rodents.

Table 4. Inhalation Atmosphere Summary

	Target Concentration	0 (mg/m³)	200 (mg/m³)	700 (mg/m³)	2000 (mg/m³)
Chamber Temperature (°C)	Mean	23.3	22.6	22.5	22.1
	SD	0.4	0.4	0.4	0.4
	N	70	70	70	70
Chamber Concentration (mg/m³)	Mean	-0.13	200.6	705.6	2001.8
	SD	0.15	2.3	13.7	29.5
Gravimetric Concentration (mg/m³) (% of total concentration)	Mean	1.22	1.74	3.54	46.57
	SD	1.36	1.37	0.76	5.49
	%	0	0.8	0.5	2.0
Particle Size from APS	MMAD (µm)	3.63	1.24	1.86	3.38
	GSD	1.81	1.74	1.87	1.87
Particle Size from Impactor	MMAD (µm)	2.29	2.53	2.29	2.33
	GSD	3.39	2.98	2.89	2.23

Note: GSD = geometric standard deviation; MMAD = mass median aerodynamic diameter; N = number; NA = not applicable; SD = standard deviation

4.2 Clinical Observations

No animals died unexpectedly or required early euthanasia during this study. On each exposure day, general observations were recorded prior to loading the rats into the exposure chambers, and then immediately following unloading. A single animal in the low concentration (200 mg/m³) was reported to have a bloody toe on exposure day 64, with no subsequent abnormal observations.

Body weights were recorded prior to loading. Three incidences of the body weights being lower than the previous observation day (greater than 5 percent) were recorded in the medium exposure group (700 mg/m³). Two similar incidences were recorded in the high exposure group (2000 mg/m³). Each incidence involved a different rat and occurred on various dates between exposure days 6 and 64. Additionally, a single body weight incident was recorded for one rat in the micronucleus control group on exposure day 5. As the weight decreases did not continue in any individual, these events are considered mere observations.

Incidence of eye crust was also recorded in all exposure groups, including controls. Although the occurrence of the eye crust reports increased in the medium and high exposure groups, exceeding the number of reports in the control group, the majority of the reports in each of these groups came from one or two rats with apparently chronic occurrence of eye crust. This could just be the result of individual sensitivities at increasing concentrations. Detailed clinical observation tables can be found in Appendix C.

4.3 Body Weight Results

Individual body weight data may be found in Appendix C. Two rats were excluded from use in the 90-day study due to low body weight; they were, instead, used in the micronucleus study as control animals. All animals included in the 90-day study were within 20 percent of the mean weight for their sex prior to group assignment. Statistical comparisons were made on a pre-exposure day and on study days 4, 23, 41, 59, and 69 (representing beginning, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and final weights, respectively).

There were no statistical differences between male or female body weights over the course of the study (Figures 1 and 2). Percent change in body weight and body weight gain data were also examined; these parameters were not statistically different across treatment groups.

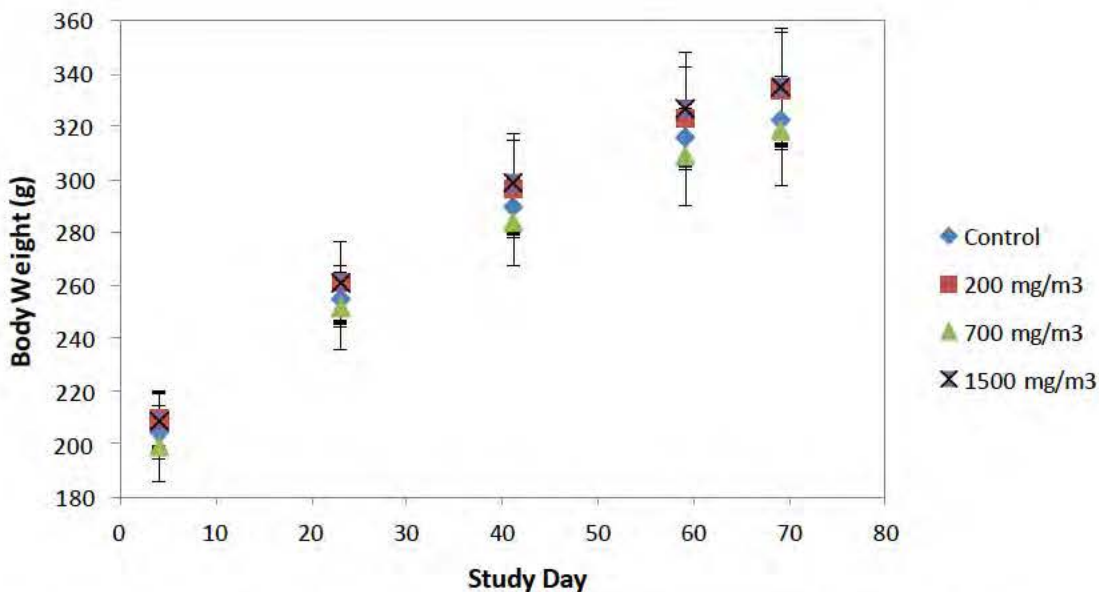


Figure 1. Average Body Weight in Male Rats (mean \pm standard deviation, n=10)

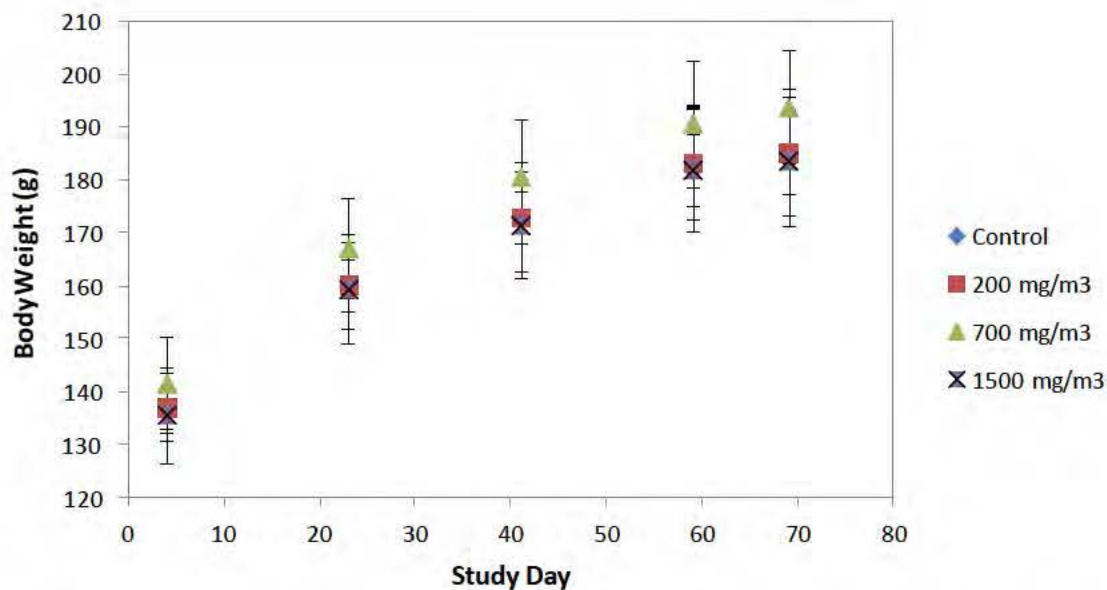


Figure 2. Average Body Weight in Female Rats (mean \pm standard deviation, n=10)

4.4 Food Consumption

Food consumption was measured by weighing food trays on a daily basis and calculating an average weekly rate. Male and female food consumption rates are shown in Figures 3 and 4, respectively. Individual food consumption data are found in Appendix C. The males in the 200 and 1500 mg/m³ exposure groups consistently ate significantly more food than the control group, whereas the 700 mg/m³ exposure group ate less, sometimes significantly less. Female rats did not differ greatly in the consumption pattern across exposure groups. Only in week 5 did one group (700 mg/m³ exposure) eat a significantly different amount than the female control rats.

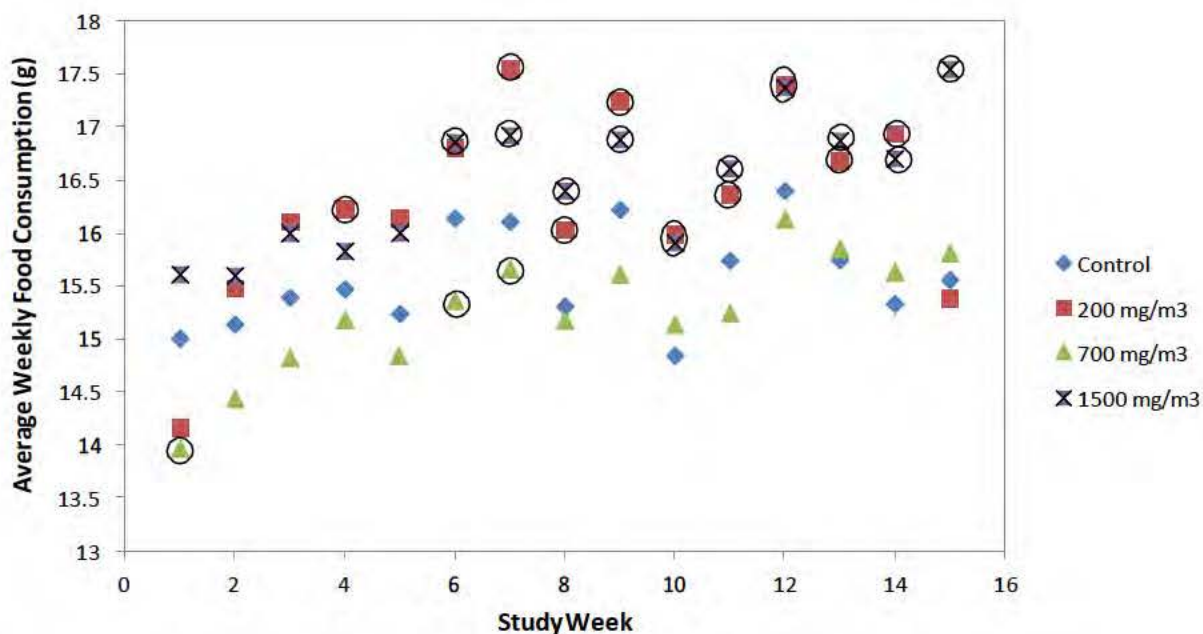


Figure3. Average Weekly Food Consumption for Male Rats. Circled values were significantly different from the control value for the respective week ($p < 0.05$).

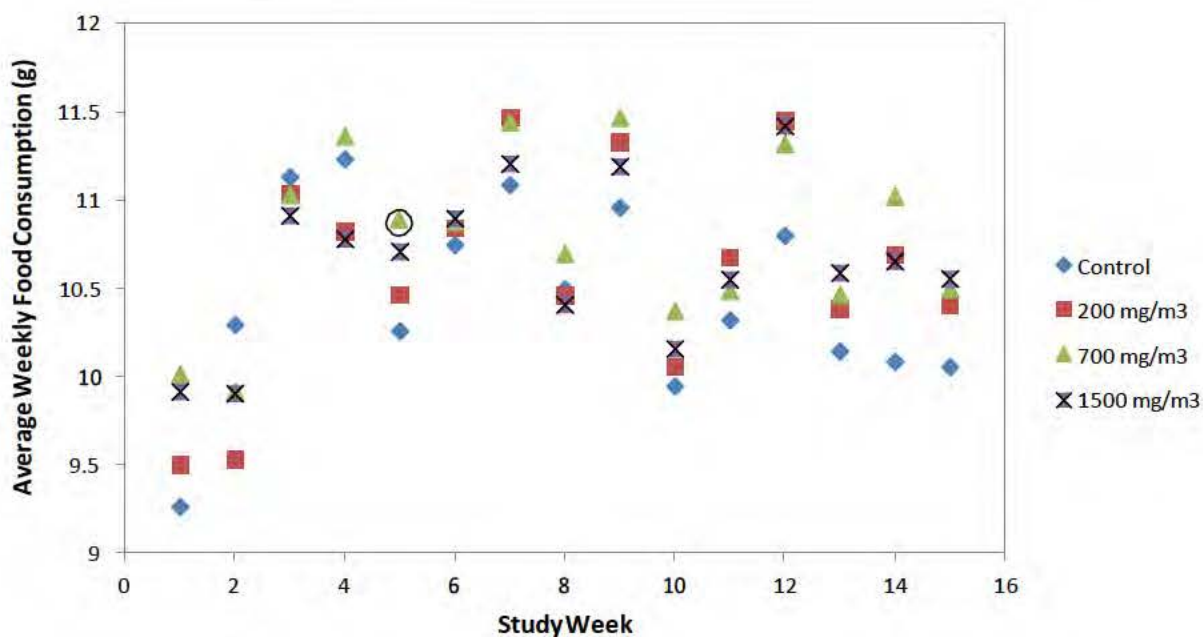


Figure 4. Average Weekly Food Consumption for Female Rats. The circled value was significantly different from the control value for the respective week ($p < 0.05$).

4.5 Ophthalmological Exams

Ophthalmologic examinations were conducted by the attending veterinarian, LTC Karyn Armstrong (711 HPW/RHDV, WPAFB OH) prior to the start of exposures. At the initial exam, two rats were excluded from the 90-day study due to pupil response problems; these two animals were then assigned to the micronucleus study control groups. Individual data are found in Appendix C.

At the start of the 14th exposure week, eye examinations were again performed. Porphyrin deposits in one eye were noted in a single rat from each of the control, 200, and 2000 mg/m³ exposure groups. Two rats with single eye deposits were found in the 700 mg/m³ exposure group. A separate animal in the 700 mg/m³ exposure group presented with a protruding (exophthalmic) right eye. The single rat in the 2000 mg/m³ exposure group with porphyrin deposits also presented with peri-ocular alopecia (hair loss) and protrusion of the right eye only.

4.6 Neurotoxicity Results

A summary of neurotoxicity tests for male and female rats exposed by inhalation to Gevo (bio) fuel are shown in Table 5. Individual results are found in Appendix D.

Table 5. Summary Neurotoxicity Assay Results for Male and Female Rats exposed to Gevo (bio) Fuel

Neurotoxicity Assay	Gevo (bio) Fuel Exposure Groups			
	Control	200 mg/m ³	700 mg/m ³	2000 mg/m ³
Motor Activity in Male Rats				
Total Distance (cm)	3215 ± 215	3478 ± 235	3143 ± 169	3591 ± 219
Total Activity (out of 3600 seconds)	1892 ± 52	1947 ± 97	1872 ± 80	1997 ± 90
Percent Time in Center vs. Perimeter	49.8 ± 1.3	50.3 ± 1.7	51.2 ± 2.1	53.7 ± 2.2
Stereotypical Activity (beam breaks)	388.4 ± 17.8	396.2 ± 11.4	406.4 ± 12.5	425.4 ± 12.4
Rears (beam breaks)	89.9 ± 5.6	100.8 ± 10.7	102.4 ± 11.2	102.8 ± 12.1
FOB Tests in Male Rats				
Rears (number in 120 seconds)	12.2 ± 1.4	14.1 ± 1.6	12.9 ± 1.4	13.1 ± 1.0
Stereo Grooming (number in 120 seconds)	2.7 ± 0.5	2.9 ± 0.5	2.9 ± 0.5	2.9 ± 0.3
Hind Splay (mm)	79.1 ± 6.1	85.5 ± 7.3	92.0 ± 5.5	85.45 ± 7.1
Forelimb Grip (kg to release)	0.41 ± 0.04	0.35 ± 0.04	0.38 ± 0.04	0.40 ± 0.02
Hindlimb Grip (kg to release)	0.12 ± 0.01	0.10 ± 0.01	0.12 ± 0.01	0.11 ± 0.01
Motor Activity in Female Rats				
Total Distance (cm)	2857 ± 239	2772 ± 207	2921 ± 239	3427 ± 240
Total Activity (out of 3600 seconds)	1828 ± 66	1767 ± 91	1944 ± 98	2232 ± 70*
Percent Time in Center vs. Perimeter	43.3 ± 2.5	40.8 ± 2.1	39.3 ± 1.5	44.5 ± 1.9
Stereotypical Activity (beam breaks)	448.3 ± 11.6	427.9 ± 22.2	450.4 ± 24.7	444.5 ± 12.8
Rears (beam breaks)	109.7 ± 6.6	119.2 ± 11.2	109.5 ± 13.4	145.7 ± 7.8
FOB Tests in Female Rats				
Rears (number in 120 seconds)	16.0 ± 0.7	14.6 ± 1.0	16.2 ± 1.4	15.4 ± 1.2
Stereo Grooming (number in 120 seconds)	3.2 ± 0.4	3.7 ± 0.3	4.0 ± 0.5	3.9 ± 0.4
Hind Splay (mm)	60.9 ± 4.5	61.6 ± 2.5	56.9 ± 5.3	58.7 ± 5.4
Forelimb Grip (kg to release)	0.29 ± 0.03	0.26 ± 0.02	0.31 ± 0.03	0.27 ± 0.02
Hindlimb Grip (kg to release)	0.07 ± 0.01	0.08 ± 0.01	0.09 ± 0.01	0.09 ± 0.01

Note: Results indicate the group mean ± standard deviation. Bolded data indicate significant differences;* denotes significance at P > 0.05 as compared to control values.

4.6.1 Motor Activity. No significant differences between exposure groups were detected for the males for any of the motor activity measurements (Table 5 above). Analyses for total distance, activity time, average speed, average rears, stereotypical activity, and habituation

activity over 60 minutes provided no significant differences between exposure groups. Figure 5 shows the total activity habituation (beam breaks) in 10 minute blocks over 60 minutes for the male rats. There was an expected main effect for block time with decreased activity over the 60 minutes but no main effect for exposure group or interaction for exposure group and time block.

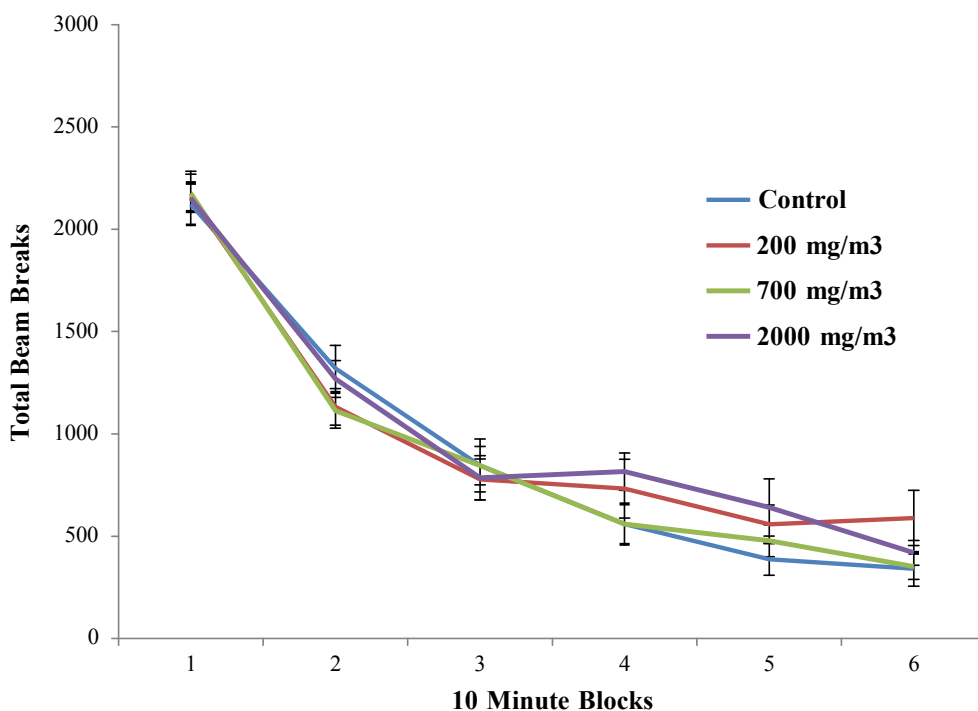


Figure 5. Motor Activity for Male Rats exposed to Gevo (bio) Fuel. Colored lines indicate group average; bars indicate standard deviation.

No significant differences between exposure groups were detected for the females for any of the motor activity measurements with the exception of total activity time, where the 2000 mg/m³ exposure group females were significantly more active than the controls ($p = 0.008$) and the 200 mg/m³ exposure group females ($p = 0.002$). No differences in activity and rearing were found at any given 10-minute time period; the only differences were found in the sum totals (Figure 6). The 2000 mg/m³ exposure group females also demonstrated more rearing behavior overall, but this was not statistically significant at $p < 0.05$. Analyses for total distance, average speed, average rears, percent time in center vs. perimeter, stereotypical activity and habituation activity over 60 minutes provided no significant differences between exposure groups. The expected main effect of increased block time and decreased activity, showing habituation, is shown in Figure 6 as well.

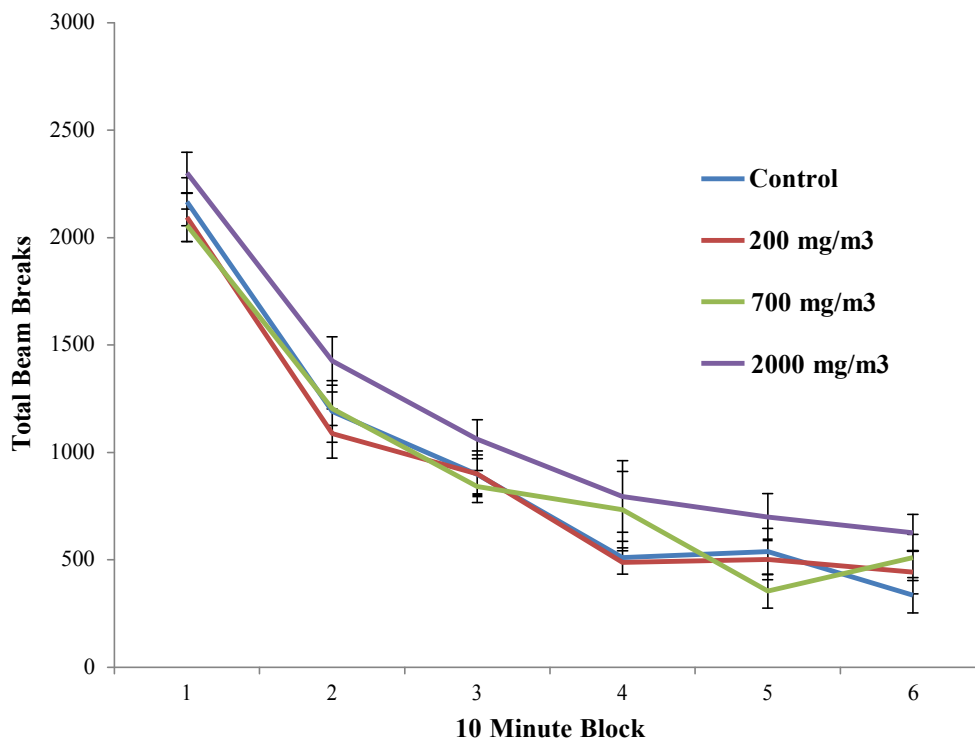


Figure 6. Motor Activity for Female Rats exposed to Gevo (bio) Fuel. Colored lines indicate group average; bars indicate standard deviation.

4.6.2 Functional Observational Battery. For male rats, all FOB observations (cage side, open field, and manipulation tests) showed no dose related effects. Results for rears, stereotypical grooming bouts, hind limb splay, and forelimb and hindlimb grip strengths are shown in Table 5 (above).

Open field and manipulation tests results for the female rats showed no dose related effects. Numeric results for rears, stereotypical grooming bouts, hind limb splay, and forelimb and hindlimb grip strengths are shown in Table 5 (above). The only effect in cage side observations was the fur appearance, where the occurrence of urine stains varied between exposure groups. Figure 7 shows the increase of urine stains with the increase in exposure level (Chi-square = 9.829 with 3 degrees of freedom; $P = 0.020$).

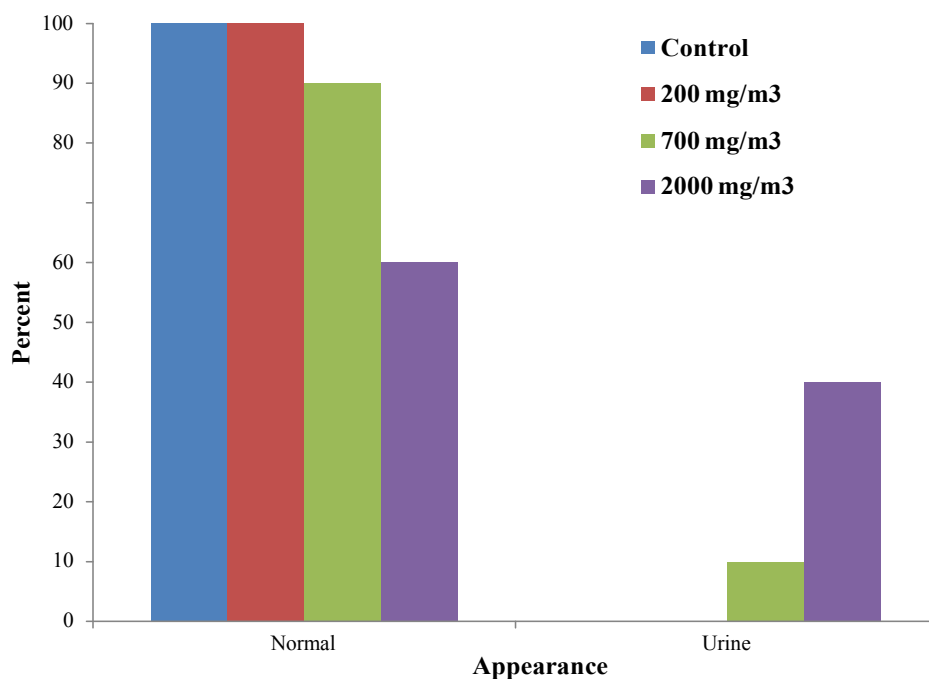


Figure 7. FOB Urine Stain Incidence for Female Rats exposed to Gevo (bio) Fuel. Percent occurrence of normal appearance or urine stained fur in female rats.

4.7 Vaginal Cytology

The vaginal lavage and cytology identified the predominant cell type present each day over a five-day span. The cell types were used to categorize each portion of the cycle: proestrus, estrus, metestrus and diestrus. All of the exposed female rats appeared to be progressing through the cycle, regardless of exposure to the Gevo (bio) jet fuel at any concentration. While several of the rats were found to be cycling “abnormally” (meaning an estrus phase lasting three or more days, or a diestrus phase lasting four or more days), these rats spanned all exposure groups. No statistically significant differences were found between the groups. Individual vaginal cytology data are found in Appendix E.

4.8 Sperm Parameters

Sperm counts, percent overall motility, and the percent of rapidly motile sperm were evaluated immediately following euthanasia and were not statistically different between exposure groups. Similarly, the number of cells evaluated in morphological testing, the percent normal, the number of sperm with abnormal heads, and the number with abnormal tails were also not different among exposed animals, when compared with the control rats. Individual data are found in Appendix F.

4.9 Gross Pathology

During necropsy, there were observations of spots or patches on some lungs, across exposure groups. Additionally, a single note of a corpus hemorrhagicum on an ovary was made in the 700 mg/m³ exposure group. A table of gross pathology observations and necropsy notes is located in Appendix G.

4.10 Organ Weights

Organs were weighed at necropsy. The average weight and standard deviation by exposure group were compiled for each organ system for both male and female rats (Tables 6 and 7). Organ weight to body weight ratios were calculated and presented in each table. Individual data tables are located in Appendix G.

Spleen weights were significantly lower in the 700 mg/m³ exposure group males. The 200 and 2000 mg/m³ exposure group male rat spleen weights were slightly higher but not different from control weights. Similarly, female spleen weights were somewhat higher in the 200 and 700 mg/m³ exposure groups but not significantly different from control values.

Table 6. Average Organ Weights for Male Rats at Necropsy

Organ		Exposure Group			
		Control	200 mg/m ³	700 mg/m ³	2000 mg/m ³
Body Weight	Average (g)	322.36	329.38	316.38	333.75
	SD (g)	11.20	20.59	19.85	20.05
Spleen	Average (g)	0.69	0.73	0.64*	0.70
	SD (g)	0.03	0.06	0.04	0.08
	% BW (mean)	0.21	0.22	0.20	0.21
	% BW (SD)	0.01	0.03	0.02	0.01
Heart	Average (g)	0.87	0.87	0.83	0.84
	SD (g)	0.07	0.07	0.05	0.07
	% BW (mean)	0.27	0.26	0.26	0.25
	% BW (SD)	0.02	0.02	0.01	0.02
Thymus	Average (g)	0.24	0.24	0.27	0.23
	SD (g)	0.06	0.05	0.05	0.04
	% BW (mean)	0.08	0.07	0.09	0.07
	% BW (SD)	0.02	0.02	0.02	0.01
Brain	Average (g)	1.91	1.90	1.89	1.92
	SD (g)	0.05	0.05	0.07	0.04
	% BW (mean)	0.59	0.58	0.60	0.58
	% BW (SD)	0.02	0.04	0.02	0.04
Right Kidney	Average (g)	0.99	1.04	0.98	0.99
	SD (g)	0.06	0.07	0.07	0.07
	% BW (mean)	0.31	0.32	0.31	0.30
	% BW (SD)	0.02	0.02	0.02	0.03
Left Kidney	Average (g)	1.02	1.05	0.96	1.00
	SD (g)	0.06	0.08	0.08	0.04
	% BW (mean)	0.32	0.32	0.30	0.30
	% BW (SD)	0.02	0.02	0.02	0.02
Adrenal Glands	Average (g)	0.05	0.05	0.06	0.06
	SD (g)	0.02	0.01	0.02	0.02
	% BW (mean)	0.02	0.02	0.02	0.02
	% BW (SD)	0.01	0.005	0.005	0.01
Liver	Average (g)	10.15 ^a	10.51	9.98	10.89
	SD (g)	0.46 ^a	0.93	0.78	0.63
	% BW (mean)	3.17 ^a	3.19	3.16	3.26
	% BW (SD)	0.13 ^a	0.14	0.17	0.10
Right Epididymis	Average (g)	0.48	0.47	0.45	0.48
	SD (g)	0.04	0.03	0.03	0.02
	% BW (mean)	0.15	0.14	0.14	0.14
	% BW (SD)	0.02	0.01	0.01	0.01
Right Testicle	Average (g)	1.52	1.54	1.48	1.52
	SD (g)	0.08	0.05	0.07	0.08
	% BW (mean)	0.47	0.47	0.47	0.46
	% BW (SD)	0.04	0.02	0.03	0.02
Left Epididymis	Average (g)	0.49	0.47	0.47	0.47
	SD (g)	0.04	0.08	0.04	0.05
	% BW (mean)	0.15	0.14	0.15	0.14
	% BW (SD)	0.01	0.03	0.02	0.01
Left Testicle	Average (g)	1.56	1.51	1.55	1.58
	SD (g)	0.08	0.24	0.07	0.08
	% BW (mean)	0.48	0.46	0.49	0.47
	% BW (SD)	0.03	0.08	0.03	0.02

Note: Bolded data indicate significant differences; * P < 0.05, statistical significance from control group; ^aValue based on n=9: result from one rat was excluded due to a recording error which resulted in an organ weight not physiologically plausible and not substantiated by reports of gross abnormality at necropsy

Table 7. Average Organ Weights for Female Rats at Necropsy

Organ		Exposure Group			
		Control	200 mg/m ³	700 mg/m ³	2000 mg/m ³
Body Weight	Average (g)	182.39	181.61	190.92	181.76
	SD (g)	7.28	11.24	10.59	12.47
Spleen	Average (g)	0.47	0.49	0.52	0.48
	SD (g)	0.05	0.03	0.04	0.03
	% BW (mean)	0.26	0.27	0.27	0.27
	% BW (SD)	0.02	0.02	0.02	0.02
Heart	Average (g)	0.54	0.54	0.56	0.53
	SD (g)	0.08	0.06	0.04	0.06
	% BW (mean)	0.30	0.29	0.29	0.29
	% BW (SD)	0.04	0.02	0.02	0.02
Thymus	Average (g)	0.24	0.23	0.25	0.26
	SD (g)	0.03	0.04	0.04	0.3
	% BW (mean)	0.13	0.13	0.13	0.14
	% BW (SD)	0.02	0.02	0.02	0.01
Brain	Average (g)	1.78	1.77 ^a	1.79	1.77
	SD (g)	0.04	0.04 ^a	0.04	0.06
	% BW (mean)	0.98	0.97 ^a	0.94	0.98
	% BW (SD)	0.03	0.06 ^a	0.06	0.05
Right Kidney	Average (g)	0.61	0.57	0.65	0.63
	SD (g)	0.04	0.05	0.09	0.08
	% BW (mean)	0.33	0.31	0.34	0.34
	% BW (SD)	0.02	0.03	0.04	0.03
Left Kidney	Average (g)	0.62	0.62	0.65	0.64
	SD (g)	0.07	0.04	0.07	0.05
	% BW (mean)	0.34	0.34	0.34	0.35
	% BW (SD)	0.03	0.02	0.04	0.02
Adrenal Glands	Average (g)	0.06	0.05	0.06	0.06
	SD (g)	0.01	0.01	0.01	0.01
	% BW (mean)	0.03	0.03	0.03	0.03
	% BW (SD)	0.004	0.004	0.007	0.005
Liver	Average (g)	5.39	5.39	5.59	5.61
	SD (g)	0.30	0.61	0.49	0.49
	% BW (mean)	2.95	2.97	2.94	3.08
	% BW (SD)	0.12	0.24	0.33	0.12
Uterus & Ovaries	Average (g)	0.68	0.76	0.85	0.66
	SD (g)	0.25	0.24	0.34	0.21
	% BW (mean)	0.38	0.42	0.44	0.36
	% BW (SD)	0.15	0.13	0.17	0.10
Uterus	Average (g)	0.59	0.62	0.73	0.54
	SD (g)	0.25	0.27	0.33	0.22
	% BW (mean)	0.32	0.34	0.38	0.29
	% BW (SD)	0.15	0.15	0.17	0.11
Ovaries	Average (g)	0.10	0.14	0.12	0.12
	SD (g)	0.004	0.05	0.04	0.05
	% BW (mean)	0.05	0.08	0.06	0.06
	% BW (SD)	0.004	0.03	0.02	0.02

Note: ^aValue based on n=9: result from one rat was excluded due to a recording error which resulted in an organ weight not physiologically plausible and not substantiated by reports of gross abnormality at necropsy

4.11 Pathology

Tissues were collected at necropsy and preserved in formalin. The tissues were embedded in paraffin, cut into 5 μm slices, and stained with hematoxylin and eosin. Tissues were then shipped to LTC Deidre Stoffregen (DVM, PhD, DACVP) for histopathology. The full pathology report can be found in Appendix H.

Mild to moderate irritation-related lesions in the nasal respiratory epithelium occurred in both males and females among the 2000 mg/m^3 exposure group. Minimal severity lesions in the olfactory epithelium of the nasal cavity occurred with low frequency among the 700 mg/m^3 (aerosol/vapor) exposed rats; these lesions did not appear to exceed background (control) incidence. Mild to moderate intensity lesions were found with frequency only among the 2000 mg/m^3 exposure group. Similarly, minimal to mild goblet cell hyperplasia also occurred only in the 2000 mg/m^3 exposure group. Female rats exhibited more nasal lesions than male rats across both types of epithelium.

In the lungs, inflammatory infiltrates were observed due to focal deficits in clearance. Infiltrates were increased in number and severity in the high exposure group due to the irritation of fuel exposure.

Early stage chronic progressive glomerulonephropathy (CPG) was observed in all rats and is an age-related disease common in F344 rats. The severity of findings increased with increased fuel exposure in male rats due to hydrocarbon nephropathy.

4.12 Clinical Chemistry and Hematology

Clotting effectiveness as expressed by the PT-P (seconds) and the INR (unitless) did not significantly differ for either male or female rats in any of the exposure groups compared with the control animals. Individual values and group means can be found in Appendix I.

No significant differences were found in any clinical chemistry analytes between exposed male rats and control males. Individual clinical chemistry data for male and female rats can be found in Appendix I.

All clinical chemistry analytes in exposed female rats were also similar to controls, except for creatinine. Control female rats had average (\pm standard deviation) creatinine levels of 0.29 ± 0.03 mg/dL . Creatinine levels were 0.27 ± 0.05 , 0.31 ± 0.07 , and 0.24 ± 0.05 mg/dL for the 200, 700, and 2000 mg/m^3 , respectively. Only the 2000 mg/m^3 exposure group was significantly different from controls. Statistically speaking, the data were non-normally distributed and were reported as 0.2 or 0.3 mg/dL . A Kruskal-Wallis ANOVA indicated that the median value of the 2000 mg/m^3 exposure group (0.2 mg/dL) was different from the median control value (0.3 mg/dL). The shortage of significant digits in the reporting of this analyte may have affected the outcome. Additionally, the lack of dose response (i.e., lower, higher, lower than control) makes the biological significance of this difference questionable.

Several hematological parameters were significantly different from the control values in both male and female rats (Tables 8 and 9). Exposed male rats showed a trend toward increasing white blood cells (WBCs) with increasing exposure; the difference was significant in only the 2000 mg/m³ exposure group but is still within normal range (Table 8). Although there were several statistically significant values across exposure groups, a solid dose-response trend did not hold for any of the WBC subtypes. However, neutrophils were significantly increased in the 2000 mg/m³ exposure group, which could be a result of changes seen in the respiratory system (Section 4.11). No definite dose-response relationships were found in any other hematology parameter, even though there were several statistically significant incidences spread over the exposure groups.

As shown in Table 9, some hematological parameters in females were significantly different from controls. However, none of the changes followed a dose-response pattern. Therefore they are considered to have little biological significance. Individual hematology data for male and female rats can be found in Appendix I.

Table 8. Hematology Parameter Values for Male Rats exposed 90-Days to Gevo (bio) Fuel

Parameter Abbreviation, Definition (units)		Exposure Group Values (mean ± standard deviation)			
		Control	200 mg/m ³	700 mg/m ³	2000 mg/m ³
WBC	White blood cells (cells/μL)	6.88 ± 1.06	7.22 ± 0.40	7.57 ± 0.71	7.83^a ± 0.73
NE#	Neutrophils (cells/μL)	1.84 ± 0.26	2.20* ± 0.39	2.02 ± 0.27	2.35* ± 0.47
LY#	Lymphocytes (cells/μL)	4.35 ± 0.97	4.33 ± 0.37	4.84^a ± 0.64	4.68 ± 0.75
MO#	Monocytes (cells/μL)	0.67 ± 0.23	0.68 ± 0.14	0.70 ± 0.20	0.79 ± 0.22
EO#	Eosinophils (cells/μL)	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01
BA#	Basophils (cells/μL)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
NE%	Neutrophils (%)	27.22 ± 4.40	30.35^b ± 4.22	26.83 ± 3.95	30.03^b ± 5.59
LY%	Lymphocytes (%)	62.79 ± 6.27	60.03 ± 4.92	63.79 ± 5.16	59.53^b ± 6.53
MO%	Monocytes (%)	9.83 ± 3.14	9.48 ± 2.05	9.18 ± 2.39	10.25 ± 3.14
EO%	Eosinophils (%)	0.14 ± 0.14	0.13 ± 0.11	0.16 ± 0.15	0.17 ± 0.18
BA%	Basophils (%)	0.02 ± 0.03	0.02 ± 0.03	0.04 ± 0.05	0.02 ± 0.03
RBC	Red blood cells (cells/μL)	9.28 ± 0.23	9.52^c ± 0.26	9.45* ± 0.26	9.35 ± 0.24
Hb	Hemoglobin (g/dL)	17.49 ± 0.59	17.30 ± 0.52	17.57 ± 0.68	17.25 ± 0.61
HCT	Hematocrit (%)	49.50 ± 1.09	49.89 ± 1.68	50.07 ± 1.20	49.60 ± 1.64
MCV	Mean corpuscular volume (fL/cell)	53.34 ± 0.83	52.40^{abc} ± 0.93	53.02 ± 0.76	53.05 ± 0.75
MCH	Mean corpuscular hemoglobin (pg/cell)	18.85 ± 0.58	18.18^b ± 0.65	18.61 ± 0.47	18.44* ± 0.50
MCHC	Mean corpuscular hemoglobin concentration (g/dL)	35.35 ± 1.32	34.73 ± 1.53	35.09 ± 1.02	34.80 ± 1.18
RDW	Red cell distribution width (fL/cell)	16.37 ± 0.66	16.71 ± 0.50	16.50 ± 0.56	16.49 ± 0.48
PLT	Platelets (cells/μL)	642.80 ± 52.48	682.50* ± 43.04	619.28 ± 160.64	684.60* ± 44.78
MPV	Mean platelet volume (fL/cell)	6.930 ± 0.20	6.96 ± 0.23	7.03 ± 0.63	6.88 ± 0.25

Note: Bolded data indicate significant differences; *Different from control group (p<0.05a); ^aDifferent from 200 mg/m³ exposure group; ^bDifferent from 700 mg/m³ exposure group; ^cDifferent from 2000 mg/m³ exposure group

Table 9. Hematology Parameter Values for Female Rats exposed 90-Days to Gevo (bio) Fuel

Parameter Abbreviation, Definition (units)		Exposure Group Values (mean ± standard deviation)			
		Control	200 mg/m ³	700 mg/m ³	2000 mg/m ³
WBC	White blood cells (cells/μL)	5.85 ± 0.81	6.07 ± 0.87	6.16 ± 1.17	5.81 ± 1.07
NE#	Neutrophils (cells/μL)	1.03 ± 0.12	1.21 ± 0.26	1.41^{*c} ± 0.44	1.09 ± 0.28
LY#	Lymphocytes (cells/μL)	4.27 ± 0.69	4.25 ± 0.77	4.00 ± 1.01	4.14 ± 0.72
MO#	Monocytes (cells/μL)	0.54 ± 0.24	0.61 ± 0.18	0.74 ± 0.40	0.58 ± 0.28
EO#	Eosinophils (cells/μL)	0.006 ± 0.007	0.005 ± 0.007	0.016^{ac} ± 0.016	0.006 ± 0.012
BA#	Basophils (cells/μL)	0.00 ± 0.01	0.0 ± 0.0	0.00 ± 0.01	0.00 ± 0.01
NE%	Neutrophils (%)	17.73 ± 2.06	19.96[*] ± 3.42	23.27^{*c} ± 8.37	18.69 ± 2.58
LY%	Lymphocytes (%)	72.92 ± 4.79	69.75 ± 4.43	64.79^{*c} ± 11.67	71.56 ± 4.55
MO%	Monocytes (%)	9.19 ± 3.79	10.19 ± 3.46	11.62 ± 5.73	9.60 ± 3.83
EO%	Eosinophils (%)	0.11 ± 0.10	0.08 ± 0.09	0.27^{ac} ± 0.31	0.11 ± 0.20
BA%	Basophils (%)	0.06 ± 0.14	0.01 ± 0.03	0.05 ± 0.11	0.04 ± 0.09
RBC	Red blood cells (cells/μL)	8.22 ± 0.38	8.15 ± 0.60	8.21 ± 0.83	8.14 ± 0.52
Hb	Hemoglobin (g/dL)	16.10 ± 0.86	16.12 ± 1.30	16.52 ± 1.32	16.16 ± 1.15
HCT	Hematocrit (%)	47.95 ± 2.37	47.44 ± 3.54	48.11 ± 4.94	47.54 ± 3.16
MCV	Mean corpuscular volume (fL/cell)	58.37 ± 0.55	58.18 ± 0.63	58.55 ± 0.70	58.37 ± 0.44
MCH	Mean corpuscular hemoglobin (pg/cell)	19.61 ± 0.61	19.78 ± 0.79	20.25 ± 1.72	19.85 ± 0.64
MCHC	Mean corpuscular hemoglobin concentration (g/dL)	33.59 ± 1.07	33.99 ± 1.31	34.60 ± 3.19	33.99 ± 1.20
RDW	Red cell distribution width (fL/cell)	14.44 ± 0.47	14.35 ± 0.45	14.39 ± 0.32	14.23 ± 0.28
PLT	Platelets (cells/μL)	632.30 ± 65.92	640.40 ± 52.47	627.85 ± 160.77	624.80 ± 79.17
MPV	Mean platelet volume (fL/cell)	6.63 ± 0.29	6.63 ± 0.36	7.00 ± 0.65	6.60 ± 0.23

Note: Bolded data indicate significant differences; ^{*}Different from control group (p<0.05a); ^aDifferent from 200 mg/m³ exposure group; ^bDifferent from 700 mg/m³ exposure group; ^cDifferent from 2000 mg/m³ exposure group

4.13 α_{2u}-Globulin

The protein α_{2u}-globulin was measured in kidney samples for both female and male rats. See Appendix J for individual animal results. Levels in female kidney samples were more than two

orders of magnitude lower than in males. The α_{2u} -globulin concentrations found in the female exposed groups were not significantly different from the female control group. The level of α_{2u} -globulin found in male rat kidneys increased with increased exposure to the fuel. Concentrations in the 700 and 2000 mg/m³ exposure groups were sufficiently increased to be statistically different (Table 10).

Table 10. α_{2u} -Globulin Concentrations in Rats exposed 90-days to Gevo (bio) Fuel

Sex	Exposure Groups			
	Control	200 mg/m ³	700 mg/m ³	2000 mg/m ³
Male	33.42 ± 9.65	39.30 ± 12.82	50.88* ± 11.51	52.00* ± 13.86
Female	0.17 ± 0.076	0.16 ± 0.10	0.29 ± 0.22	0.22 ± 0.14

Note: Values are mean (μ g α_{2u} -globulin/mg tissue) \pm standard deviation; Bolded data indicate significant differences; *Values are statistically different from control ($p < 0.05$).

4.14 Micronuclei Assessment

Following a two-week exposure to Gevo (bio) fuel, rats showed no significant difference in the percentage of reticulocytes compared with air-exposed controls, with one exception. The male rats in the 700 mg/m³ exposure group showed an increase in percent reticulocytes; however, the increase was not indicated in either of the other exposed groups and was similar to the vehicle (saline) control value (Table 11). The percent of reticulocytes decreased sharply, as expected, in the positive control (cyclophosphamide) group.

Conversely, the percentage of micronucleated reticulocytes increased significantly in the positive control group, indicating genotoxicity. In contrast, the Gevo (bio) exposed animals did show a trend toward decreased micronucleated reticulocytes, with the difference being significant among the 2000 mg/m³ exposure group. The percent of micronucleated reticulocytes among all inhalation groups (0, 200, 700, and 2000 mg/m³ Gevo (bio)) were lower than the vehicle control percentages. Individual micronucleus assay data can be found in Appendix K.

Table 11. Micronucleus Data in Rats exposed 90-days to Gevo (bio) Fuel

Sex	Exposure Groups				Assay Control Group	
	Control (0 mg/m ³)	200 mg/m ³	700 mg/m ³	2000 mg/m ³	Vehicle (saline)	Cyclo- phosphamide
Male					Male	
% Reticulocytes	16.69 ± 5.09	17.67 ± 3.77	27.83* 8.84	16.80 ± 5.38	28.04 ± 7.18	18.82 ± 7.77
% Micronucleated Reticulocytes	0.08 ± 0.03	0.05 ± 0.02	0.05 ± 0.03	0.02 ± 0.01	0.10 ± 0.02	0.91* 0.61
Female					Female	
% Reticulocytes	17.66 ± 6.53	20.51 ± 7.38	20.49 ± 6.85	25.94 ± 6.04	28.82 ± 5.02	10.08* ± 6.52
% Micronucleated Reticulocytes	0.07 ± 0.02	0.04 ± 0.01	0.07 ± 0.03	0.02* ± 0.02	0.08 ± 0.016	0.46* ± 0.09

Note: Values are mean ($\mu\text{g } \alpha_{2\text{u}}\text{-globulin/mg tissue}$) \pm standard deviation; Bolded data indicate significant differences; *Values are statistically different from relevant control ($p < 0.05$).

5.0 DISCUSSION

Neither male nor female rats displayed significant body weight differences or percent gain changes when exposed to Gevo (bio) ATJ SPK fuel for 90-days. The males in the 200 and 2000 mg/m³ exposure groups did consistently consume statistically higher quantities of food as compared to the control group, whereas the 700 mg/m³ exposure group males often consumed less (Figure 3). This corresponds with the trends seen in Figure 1, where the 200 and 1500 mg/m³ exposure group males weighed somewhat more than the control rats, and the 700 mg/m³ exposure group males weighed a bit less. As body weights were not significantly different, and as there is no dose-response trend observed, the increased food consumption in two groups is not considered biologically significant.

In general, a dose-dependent decrease in bodyweight is not unusual for animals exposed to high fuel concentrations. Male rats exposed to 500 or 1000 mg/m³ JP-8 vapor (23 hours/day, continuous exposure, 90-days) weighed 4.9 or 8.1 percent less than the control male rats, respectively (Mattie *et al.*, 1991); female rat weights in this study were not affected. Rats exposed to alternative jet fuels in other 90-day studies also had reduced bodyweights. In the 2000 mg/m³ exposure group for hydroprocessed esters and fatty acids from a camelina feedstock (HEFA-C) SPK, average male body weights decreased by approximately 5 percent, and female body weights decreased by 3 percent (Wong *et al.*, 2013). Rats exposed to 2000 mg/m³ Fischer-Tropsch (FT) SPK jet fuel were lighter by 12 percent in the males and 5 percent in females (Mattie *et al.*, 2011a). The lack of a clear statistical difference or dose-response trend in the current study indicates an even milder general effect associated with the Gevo (bio) fuel inhalation exposure.

Interestingly, an increase in food consumption, albeit in a non-dose-response manner, has not been reported in conjunction with previous alternative fuel inhalation exposure. Rats exposed in the HEFA-C SPK 90-day study (Wong *et al.*, 2013) ate a statistically similar amount as compared to the study control group. Mattie *et al.* (2011a) found an association between increased inhaled FT SPK fuel exposure for 90-days and decreased food consumption. Exposure

to Gevo (bio) ATJ SPK fuel for 90-days does not decrease appetite/food consumption of rats as previously seen by other jet fuels.

Ophthalmological exams indicated incidences of porphyrin deposits in one or two rats per group, across all exposures and control groups. Porphyrin is a red-colored lacrimal secretion from the Harderian gland, and may be associated with general stress to the animal (Heywood, 1982). Since this effect presented without association with dose, the stressor is likely one that is due to the handling received by rats of all groups. One rat in each of the 700 and 2000 mg/m³ Gevo (bio) ATJ SPK fuel exposure groups displayed an exophthalmic or protruding eye. Since this occurred in only one eye on each of these rats, this condition was considered to be due to injury and therefore not related to fuel exposure. Outside of random incidence of porphyrin secretion, no ophthalmic effects have been reported from exposure to other alternative fuels (Mattie *et al.*, 2011a; Wong *et al.*, 2013).

Animals were assessed for neurobehavioral function near the end of the 90-day exposure period (Table 5). Motor activity was measured during the 13th week of exposure and a FOB was performed during the 14th week. No changes in either motor activity or FOB results were observed for male rats. In the motor activity test, female rats exposed to 2000 mg/m³ Gevo (bio) ATJ SPK fuel were significantly more active, if the number of movements were totaled over the 60 minutes of observation. However, the increases were not significant when counted by 10-minute intervals (Figure 6). Many of these same high exposure female rats failed to groom themselves as regularly, which resulted in more urine stains on the fur during the FOB exam (Figure 7). A decrease in motor activity would be expected after exposure to a high concentration of hydrocarbon instead of an increase as seen in this study. Different minor neurobehavioral findings were reported during a 90-day inhalation study with another alternative fuel. While there were no significant observations relatable to exposure to HEFA-C fuel in either motor activity measurements or the FOB (Wong *et al.*, 2013), males rats exposed to 2000 mg/m³ FT SPK fuel showed a reduction in total activity. Female rats of the same group displayed reduced initial exploratory activity. FOB findings were limited to reduced rearing behavior in females exposed to 2000 mg/m³ FT SPK fuel (Mattie *et al.*, 2011a).

Although multiple neurobehavioral studies have been performed to determine JP-8 effects, none were identical to the motor activity and FOB assessments performed in this study. Changes in behavioral response were observed in two studies where rats were exposed to 0, 500, or 1000 mg/m³ JP-8 for 6 hours/day 5 days a week for 6 weeks. When animals were subjected to different operant tasks with varying levels of complexity, the low and high exposure groups scored the same as control animals on all tests except for the most complex tasks. In these two operant tests, group differences emerged; low dose animals demonstrated better performance than high dose animals while neither group performed differently from controls (Ritchie *et al.*, 2001). In a second study using the same exposure methods, animals were tested in a large battery of neurobehavioral tasks. No exposure group differences were found in acoustic startle responses, forelimb grip strength, nociception, social interaction, the forced swim test, spontaneous locomotor activity, passive avoidance or Morris water maze performance. However, differences were found in a test for behavioral sensitization. The appetitive stimulus approach sensitization assay measures the time an animal spends proximal to an appetitive stimulus versus a neutral stimulus. Animals exposed to JP-8 spent more time than control

animals investigating the appetitive stimulus, suggesting behavioral sensitization and altered neural pathways related to the dopaminergic system (Rossi *et al.*, 2001). Overall, only two very specific neurobehavioral effects of JP-8 vapor were seen after exposure in adult rats.

Reproductive endpoints in this 90-day study indicated no differences between the Gevo (bio) ATJ SPK exposed animals and controls. Kerosene range jet fuels have yet to show any reproductive abnormalities in these endpoints (sperm parameters and vaginal cytology) or other reproductive studies. Mattie *et al.* (2011a) and Wong *et al.* (2013) assessed FT and HEFA-C SPK fuels in exactly the same manner, with identical results. Petroleum-derived JP-8 was assessed in two reproductive studies performed as part of a 90-day oral investigation of JP-8 in rats (Mattie *et al.*, 1995) and reported later (Mattie *et al.*, 2000). In the first study, male rats were given 0, 750, 1500, or 3000 mg/kg neat JP-8 daily by gavage for 70 days prior to mating with naïve females to assess fertility and sperm parameters. After 70 days of dosing, body weights in the 3000 mg/kg group were over 30 percent lower than control weights; however, there were no significant changes for pregnancy rate, gestation length, or sperm parameters as compared to control values. In the second reproductive study, general toxicity, fertility and reproductive endpoints were assessed in female rats dosed with neat JP-8 (0, 325, 750, or 1500 mg/kg) daily by gavage for a total of 21 weeks (90-days plus mating with naïve males, gestation, and lactation). Results of the general toxicity endpoints revealed a significant dose-dependent decrease in body weights of the female rats. Pup weight decreased with increasing dose, likely related to maternal body weight decreases. Offspring from the 1500 mg/kg dosed females were statistically and biologically significantly lower in weight on postnatal days 4 through 21. There were no statistically significant changes from control values for gestation length, pregnancy rate, and numbers of pups per litter (Mattie *et al.*, 2000).

Animals were necropsied the day following the last exposure to Gevo (bio) ATJ fuel. Gross pathology observations were few and not related to fuel exposure. These results are consistent with HEFA-C SPK (Wong *et al.*, 2013), FT SPK (Mattie *et al.*, 2011a), and JP-8 exposures (Mattie *et al.*, 1991, 1995).

Organ weights and organ to bodyweight ratios were also evaluated during necropsy. Spleen weights in the male rats, as seen in Table 6, were heavier in the 200 and 2000 mg/m³ exposure groups but statistically lower in the 700 mg/m³ group ($P < 0.05$) as compared to control spleen weights. Liver weights among exposed male rats were higher than control in the 200 mg/m³ exposure group, lower than controls in the 700 mg/m³ group, and higher again in the 2000 mg/m³ group; these changes were not statistically significant. Exposed female rat spleen and liver weights were not different from controls. As a dose-related trend was not seen, the biological significance of the spleen and liver weight changes among exposed animals is not clear and appears to be due to random biological variability.

No biologically relevant changes in organ weight were seen in the HEFA-C SPK fuel 90-day study (Wong *et al.*, 2013). Organ weight differences seen at the high dose in the SPK study were correlated with body weight decreases and not considered to be a direct effect from the fuel (Mattie *et al.*, 2011a). JP-8 also did not produce changes in organ weights after exposure continuously for 90-days except in the male rat kidneys, where there was a significant increase in hyaline droplet formation (Mattie *et al.*, 1991).

Histopathological examination resulted in relatively few findings primarily located in the nasal regions. Respiratory epithelial lesions reported are associated with irritation response. Olfactory region findings were minimal to mild in degree in the 2000 mg/m³ exposure group. Overall, the female rats in the 2000 mg/m³ group appeared to be more greatly affected as compared to the male rats. All nasal lesions observed in the 200 and 700 mg/m³ exposure groups did not exceed incidence in the control rats. Histopathology also revealed lung inflammatory infiltrates in the 2000 mg/m³ exposure group. These infiltrates are likely due to a clearance deficit resulting from irritation.

Similar olfactory tissue effects (olfactory epithelial degeneration, goblet hyperplasia) were found among rats exposed for 90 days to 2000 mg/m³ HEFA-C SPK (Wong *et al.*, 2013) and FT SPK (Mattie *et al.*, 2011a) fuels. Respiratory epithelial hyperplasia and lung inflammatory cell infiltration were also observed in the FT SPK study 2000 mg/m³ exposure groups (Mattie *et al.*, 2011a). No histological effects were found in the nasal cavities or lungs of rats exposed to petroleum-derived JP-8 vapor for 90-days continuously (Mattie *et al.*, 1991); combined aerosol and vapor exposure may be required to produce nasal cavity tissue and lung epithelium effects. An extended time period may also be required to alter histology; no histological changes were reported in the nasal cavities or lungs after exposure to petroleum-derived Jet A for two weeks (Sweeney *et al.*, 2013).

Age-related chronic progressive glomerulonephropathy in male rats increased with Gevo (bio) fuel exposure. This correlates with significant increases of α_{2u} -globin found among male rats in the 700 and 2000 mg/m³ exposure groups (Table 10). Exposure to the other alternative fuels, FT and HEFA-C SPK fuels) result in relatively small increases of α_{2u} -globin (Mattie *et al.*, 2011a; Wong *et al.*, 2013), while petroleum-derived JP-8 strongly induces the production of this protein (Mattie *et al.*, 1991). α_{2u} -Globulin is a male rat-specific protein that produces hyaline droplets after hydrocarbon exposure, ultimately resulting in the potential for renal tubule tumors. This effect is observed in male rats with exposure to jet fuels or similar substances and is referred to as hydrocarbon nephropathy. As such, this protein-overload disease is considered to be male rat specific, which has been studied extensively, and found to be not pertinent to human health (Borghoff *et al.*, 1990; Hard *et al.*, 1993).

Statistically significant changes in clinical chemistry and hematology occurred sporadically across the standard results panel (Table 8). Lack of dose response reduces the only noteworthy effect to the change in WBC count among the male rats. Total WBCs in exposed male rats increased with increased concentration of Gevo (bio) ATJ fuel. Only the 2000 mg/m³ exposure group WBC count was significantly higher; the increase was not attributable to a significant dose-response increase in any one WBC type. Analysis of the WBC count data indicates that, due to high variability among the control rats (6.88 ± 1.06 cells/ μ L), it is unclear if the WBC count in the 2000 mg/m³ exposure group males (7.83 ± 0.73 cells/ μ L) is really biologically different as it falls within a single standard deviation and normal range for WBC counts. No significant changes attributable to exposure have been identified in the clinical chemistry and hematologic analyses for male or female rats exposed to JP-8 (Mattie *et al.*, 1991), FT SPK (Mattie *et al.*, 2011a), or HEFA-C SPK (Wong *et al.*, 2013), during their respective 90-day inhalation studies.

In conjunction with the 90-day study, Gevo (bio) ATJ SPK was assessed using the mammalian micronucleus assay. Following a two-week exposure under the same conditions as the animals in the 90-day study, rats in the micronucleus assay were euthanized and their femoral bone marrow cells were examined for the formation of micronuclei, a marker of damage to the genetic material (DNA in chromosomes) of the cell (i.e., genotoxicity). During improper cell division, damaged chromosomes may leave fragments called "micronuclei" that can be observed and the incidence measured. Damage to the cell's genetic material can cause mutations (changes) that may lead to cancer. The assay also requires the quantitation of reticulocytes, as compared to other cell types, as an indicator of bone marrow toxicity (decreased reticulocytes) or a marker of immune response (increased reticulocytes). Gevo (bio) ATJ fuel exposure resulted in a non-dose-response increase in percentage of reticulocytes in both male and female rats. As the increased number in the 700 mg/m³ exposure group is similar to the assay vehicle (saline) control percentage, it is not considered to be biologically relevant. The percent of micronucleated reticulocytes decreased in exposed rats; again, this response is not generally considered adverse as an increase in micronuclei is indicative of genotoxicity. In short, exposure to Gevo (bio) fuel resulted in no adverse effects on the bone marrow and no indication of genotoxicity. The alternative fuels FT SPK and HEFA-C were also found to be non-genotoxic through the micronucleus assay (Mattie *et al.*, 2011b; Wong *et al.*, 2013; respectively).

Alternative fuels have been tested for mutagenicity by means of the Salmonella-Escherichia coli/microsome plate incorporation assay (Ames test). Gevo (bio) ATJ SPK was found non-mutagenic by Mumy *et al.* (2015). HEFA-C and HEFA from a tallow feedstock (rendered beef fat, HEFA-T) were established as non-mutagenic by Mattie *et al.* (2013). Riccio *et al.* (2010) found HEFA from mixed fats and oils (HEFA-F) to be negative in the Ames test; HEFA-F was referred to in this study as R-8 or renewable JP-8 (POSF log book number 5469). FT SPK was shown to be non-mutagenic by the Ames assay in two studies (Mattie *et al.*, 2011c; Riccio *et al.*, 2010). SPK was also negative in a chromosomal aberration assay in which human lymphocytes were exposed to the fuel *in vitro* (Mattie *et al.*, 2011c).

JP-8 has been found to be non-mutagenic and non-genotoxic in multiple studies. The Ames assay was relatively new when Brusick and Matheson (1978) demonstrated that JP-8 was not mutagenic. In a dermal variation of the mammalian micronucleus test, mice were treated with either a single or multiple applications of JP-8 and Jet A fuels. Using several different dermal exposure regimens, no statistically significant differences in the incidence of reticulocytes or micronucleated reticulocytes was observed in the bone marrow and/or peripheral blood of mice treated with JP-8 or Jet-A when compared with those of untreated control animals (Vijayalaxmi *et al.*, 2006; Vijayalaxmi, 2011). Negative results in the combination of mutagenicity and genotoxicity assays increases the evidence that exposure to the HEFA jet fuels will not result in carcinogenic outcomes.

6.0 CONCLUSIONS

The finalization of this report on the Gevo (bio) ATJ SPK 90-day inhalation study in rats will assist the USAF in certifying the fuel for use in a 50:50 blend with petroleum-derived JP-8. The

Gevo (bio) fuel was found to cause similar effects in the nasal tissues, the primary target organ, as the other alternative fuels previously tested in this same 90-day study design (FT SPK, Mattie *et al.*, 2011a; HEFA-C, Wong *et al.*, 2013). Furthermore, Gevo (bio) ATJ SPK did not produce any unexpected toxicity in the 90-day study. Reproductive effects and evidence of genotoxicity and mutagenicity were both negative. Limited and minor neurological effects at 2000 mg/m³ were found. Inhalation of Gevo (bio), alone or in a 50:50 blend with petroleum-derived JP-8, is unlikely to increase human health risks in the military workplace.

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APPENDIX A. 90-DAY STUDY PROTOCOL

19 April 2013

**U.S. AIR FORCE SPONSORED ANIMAL RESEARCH PROPOSAL
SIGNATURE COORDINATION SHEET**

I. NAME OF FACILITY:

Naval Medical Research Unit (NAMRU) Dayton, Wright-Patterson AFB, OH

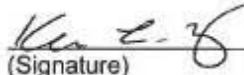
II. PROTOCOL NUMBER: F-WA-2013-0144-A

III. PROTOCOL TITLE: 90-Day Inhalation Toxicity Study of Bio-Derived Gevo Jet Fuel in Rats (*Rattus norvegicus*) with Neurotoxicity Testing and Genotoxicity Assay

IV. PRINCIPAL INVESTIGATOR:

Karen L. Mumy, Ph.D.
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Karen L. Mumy
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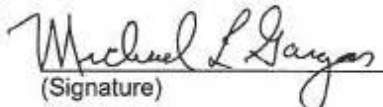

(Signature)

19 April 2013
(Date)

V. SCIENTIFIC REVIEW: This animal use proposal received appropriate peer scientific review and is consistent with good scientific research practice.

Michael L. Gargas, Ph.D.
Director, Environmental Health Effects Research
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Michael L. Gargas
(Printed Name)


(Signature)

22 APRIL 2013
(Date)

VI. STATISTICAL REVIEW: A person knowledgeable in biostatistics reviewed this proposal and ensured that the number of animals used is appropriate to obtain sufficient data and/or is not excessive, and the statistical design is appropriate for the intent of the study.

19 April 2013

Dr. Timothy S. Webb
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Timothy S. Webb
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(Signature)

24 Apr 13
(Date)

VII. ATTENDING VETERINARIAN: In accordance with Animal Welfare Regulations, the Attending Veterinarian was consulted in the planning of procedures and manipulations that may cause more than slight or momentary pain or distress, even if relieved by anesthetics or analgesics.

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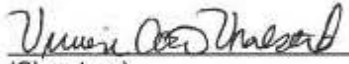

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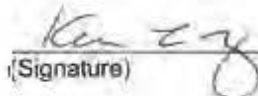
PROTOCOL TITLE

90-Day Inhalation Toxicity Study of Bio-Derived Gevo Jet Fuel in Rats (*Rattus norvegicus*) with Neurotoxicity Testing and Genotoxicity Assay

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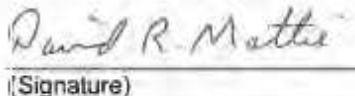

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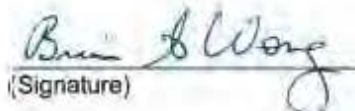
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22-Apr-2013
(Date)

I. NON-TECHNICAL SYNOPSIS

The United States military is developing alternatives to petroleum-based jet fuels. Alternatives include both synthetic and biologically-produced hydrocarbon liquids, such as the bio-derived Gevo Jet Blend Stock fuel (Gevo). As this Gevo fuel is being acquired by all three Services, there may be occupational and environmental exposure during refueling, routine maintenance, or operation of all military aircraft.

Inhalation is one of the primary routes of exposure; therefore it is important to study the effects on the lungs and body after repeatedly breathing a chemical mixture such as jet fuel. Bio-derived Gevo is designed to be equivalent to the petroleum based traditional military fuel, Jet Propulsion (JP)-8; however, the overall chemical composition may vary. Given this potential chemical variability, the health effects associated with exposure to the biologically-derived Gevo jet fuel may differ from those associated with JP-8. This study will investigate the inhalation toxicity of the bio-derived Gevo fuel over the minimum period of time necessary for regulators to establish an occupational exposure level for safe use of the fuel. Gevo will be administered to Fischer 344 rats (10 rats per sex per dose) by whole-body inhalation at three concentrations plus a control level (2000, 700, 200, and 0 mg/cubic meter) on a repeated basis (6 hours per day) for 5 days per week for 13 weeks. After a minimum number of exposures, but prior to the end of exposures, animals will undergo functional observations to evaluate any signs of toxicity related to the nervous system that may result in behavioral changes. The potential for reproductive toxicity will be studied by looking for changes in the female estrous cycle (analogous to the menstrual cycle in human females). Cells representative of the various stages of the estrous cycle will be collected by a saline wash (lavage) of the vagina of female rats. Reproductive toxicity in male rats will be evaluated from freshly collected sperm at necropsy by looking for changes in sperm concentration (number), movement (motility) and abnormal shape (morphology). At the end of exposures, the rats will be euthanized, and various tissues collected, processed, and examined by microscopy to look for evidence of tissue damage that can be related to the inhalation of Gevo fuel. Correlation of any observed tissue damage with the exposure concentration will help to establish safe exposure guidelines for use of this new class of renewable jet fuel alternatives.

A second experiment will be conducted concurrently in which F344 rats are exposed to Gevo fuel at the same concentrations listed above for a two-week period (10 exposure days). Following exposures, the animals will be euthanized and bone marrow will be extracted from the femur. The bone marrow cells will be examined for the formation of micronuclei, a marker of damage to the genetic material (DNA in chromosomes) of the cell (i.e., genotoxicity). During improper cell division, damaged chromosomes may leave fragments called “micronuclei” that can be observed and measured. Damage to the cell’s genetic material can cause mutations (changes) that may lead to cancer. This “micronucleus assay” is used to identify compounds that could be genotoxic and eventually carcinogenic. This second study will establish whether or not the bio-derived Gevo fuel has genotoxic properties.

This protocol will use 140 rats. The final disposition of all rats on this protocol will be euthanasia by an American Veterinarian Medical Association (AVMA) approved method.

II. BACKGROUND

II.1. Background

The Office of the Secretary of Defense Assured Fuels Initiative is pursuing alternative fuels for military use to decrease dependence on foreign oil sources. These fuels are being developed for use in military aircraft, ships, and ground vehicles. Fuels are among the most common sources of occupational exposures to military personnel with the primary routes of exposure being inhalation and dermal contact (Ritchie *et al.*, 2003). Preliminary analysis of the new alternative and biologically-based fuels shows that many of the ingredients are the same as Jet Propulsion (JP)-8, the conventional military fuel, but the overall composition is still different in each fuel (data not reported). Therefore, the health effects associated with exposure to each alternative fuel may also differ from those associated with JP-8 and should be evaluated individually.

One of the alternative fuels currently produced in the United States is a Fischer-Tropsch (F-T) fuel generated from natural gas. Air Force Research Laboratory Molecular Bioeffects Branch (AFRL/711 HPW/RHDJ) conducted a Toxicology Program for this F-T fuel that, along with JP-8, has provided the baseline data for comparison of alternative and biologically derived fuels (Wong *et al.*, 2010; Mattie *et al.*, 2011; Hinz *et al.*, 2012;). There are a number of bio-based jet fuels that are being considered for use and undergoing development and certification by the military. Despite being biologically-based, these new fuels need to be examined for their toxicity potential in comparison to the already certified JP-8 and F-T jet fuels. Recently, a biofuel, hydro-treated renewable jet (HRJ; now termed Hydroprocessed Esters and Fatty Acids) fuel based on oils extracted from the camelina plant (*Camelina sativa*), was evaluated for potential toxicity by the same methods described here (2011; Protocol Number F-WA-2011-0126-A). The final results of this study are in the final stages of evaluation, but indicate that HRJ from camelina is less irritating to the lungs and has reduced toxicity compared to JP-8 (personal communication). A separate biofuel, Swedish Biofuel-JP-8 (SB-JP-8), is also under consideration for military use and its potential toxicity is currently under investigation. *In vivo* 90-day inhalation exposures were recently performed for SB-JP-8 (2012-2013; Protocol Number F-WA-2012-0139-A) and while the in-life stage is complete, tissue processing and biological analyses are still underway. SB-JP-8 and bio-derived Gevo are both forms of alcohol-to-jet (ATJ) alternative jet fuel and are derived from alcohol using biomass as the original source material. Private industry has developed a process to dehydrate alcohols (butanol in the case of Gevo) and react the resulting alkene with synthesis gas in order to produce an alcohol that is one carbon longer than the starting alcohol. This process is repeated until long carbon chains are reached. The alcohol is then hydro-treated and becomes a normal alkane within the jet

fuel range. The aromatics and cycloparaffins within the jet fuel are also derived from alcohols.

A 90-day inhalation study of JP-8 jet fuel (Mattie *et al.*, 1991) was conducted with necropsies of test subjects at interim time points, at the end of exposures, and at post-exposure recovery time points. Target concentrations were 0, 500, and 1000 mg/cubic meter of JP-8 vapor with continuous exposure (24 hr/day) over 90 days. The primary effects seen in this study were body weight depression in males, but not females. JP-8 exposure by inhalation also resulted in alterations in the male rat kidney characterized by hyaline droplet formation, granular casts in the outer medulla, and nephrosis. The hyaline droplet formation and granular casts resolved during a recovery phase, however, the nephrosis did not. These observations within the kidney have been found in male rats exposed to other hydrocarbons and are considered to be specific to the male rat and have not been observed in humans.

While the Mattie *et al.* (1991) study performed a continuous exposure for 90-days, the F-T study (Wong *et al.*, 2010), as well as the 90-day inhalation studies for HRJ/HEFA-camelina (2011; Protocol Number F-WA-2011-0126-A) and SB-JP-8 (2012-2013; Protocol Number F-WA-2012-0139-A) employed a 6 hours/day, 5 days/week exposure profile to mimic occupational exposure. The U.S. EPA Health Effects Test Guidelines OPPTS 870.3465 (90-Day Inhalation Toxicity) were used to design the inhalation studies to evaluate the F-T jet fuel (Wong *et al.*, 2010; Mattie *et al.*, 2011; Hinz *et al.*, 2012). The 90-day F-T synthetic jet fuel study had a greater range of target concentrations of 0, 200, 700, and 2000 mg/cubic meter (Wong *et al.* 2010). In the high concentration (2000 mg/cubic meter) group, the average male body weight was decreased by approximately 12%, while the average female body weight decreased by 5% by the end of the exposures. Evidence of olfactory epithelial degeneration and respiratory epithelial hyperplasia was found in the nasal airways of rats exposed to the high concentration (2000 mg/cubic meter). In the lung, minimal to mild multifocal areas of inflammatory cell infiltration were observed in the high concentration (2000 mg/cubic meter) group. A lesser effect was also seen in the lungs of the intermediate exposure (700 mg/cubic meter) group. Similar to the JP-8 study, hyaline droplets were observed in male rat kidneys exposed at the highest concentration (2000 mg/cubic meter) of F-T jet fuel. It is unknown whether the bio-derived Gevo fuel will have a toxicology profile more similar to the conventional JP-8, or the alternative F-T fuel.

A study with repeated administration of a test material spanning over a 90-day period is called a subchronic study and may be used to identify adverse effects not detected in shorter-term acute studies, identify a no-observable adverse effects level (NOAEL), and provide information for regulatory agencies. The 90-day inhalation study design is a standard toxicity test that is used to provide data that can aid in establishing occupational exposure limits. The U.S. EPA Health Effects Test Guidelines OPPTS 870.3465 (90-Day Inhalation Toxicity) will be used for this 90-day inhalation study of Gevo fuel for comparison to the already certified fuels JP-8 and F-T. These guidelines indicate that 6 hours/day, 5 days/week for a minimum of 65 exposure days is appropriate for collecting the toxicology data needed for determining the occupational exposure limit of bio-derived Gevo fuel.

II.2. Literature Search for Duplication

II.2.1. Databases Searched

Biomedical Research Database (BRD), Research Portfolio Online Reporting Tool (RePORTER) (<http://projectreporter.nih.gov/reporter.cfm>), Federal Research in Progress (FEDRIP), PubMed, Ebsco, DTIC technical reports and research summaries, Toxline (TOXNET), AGRICOLA, Cambridge Scientific Abstracts, Science Direct, Engineering Village 2 (Compendex, NTIS and INSPEC), Dialog databases: BIOSIS, Embase, Enviroline, CAB Abstracts, Chemtox, Zoological records, Toxfile, Wilson Biological, Chemical Abstracts, International Pharmaceutical Abstracts, IPA Toxicology, Toxfile, BIOSIS Toxicology, BIOSIS Previews; and Independent Research and Development (IRD) database.

II.2.2. Number, Date, and Resources of Search

Search # 2013165 was completed 2/20/2013 by Ms. Michelle Burwinkel, MLS, DO-I of the D'Azzo Research Library, AFRL/RQWC.

II.2.3. Period of Search

All dates to present.

II.2.4. Key Words of Search

Jet fuel, bio-derived Gevo, Gevo Jet Blend Stock, ATJ, alcohol-to-jet, ATJ ethanol, ATJ butanol, ATJ isobutanol, ATJ cellulosic alcohol, biofuel, biobased/bio-based, toxicity/toxicology, animal, rat, mouse/mice, micronucleus, inhalation, two-week, 90-day, subchronic, 13-week, sensory irritation (in lungs = respiratory tract), RD50, Alarie

II.2.5. Results of Search

The results of this literature search found no articles for toxicity studies with bio-derived Gevo Jet Fuel, Gevo Jet Blend Stock, Gevo or alcohol-to-jet (ATJ) fuels, although related articles were found pertaining to JP-8 toxicity. Therefore, duplication of research efforts proposed for this project was not identified.

III. OBJECTIVE / HYPOTHESIS

Provided that inhalation is a major route of exposure for JP-8 jet fuel, the assessment of toxicity of Gevo fuel by inhalation is needed in order to assess the risk of either replacing or augmenting (i.e., blending) JP-8 with Gevo fuel. Gevo fuel has the potential for both vapor and aerosol (fuel droplets) exposures. The objective of this study is to assess the potential inhalation toxicity of a test substance when administered via inhalation exposure to Fischer 344 rats on a repeated basis for 90 days (5 days per week over 13 weeks, 65 total exposure days). The assessments will include clinical observations, gross pathology, clinical pathology, and histopathology. Towards the end of the study, neurotoxicological effects will be assessed using a Functional Observational

Battery and Motor Activity tests for rats exposed to Gevo fuel. In addition to histopathology of reproductive organs, reproductive toxicity will be examined via sperm concentration, motility and morphology and vaginal cytology. Data will be used to establish no effect levels and lowest effect levels that are needed for regulatory processes to establish occupational permissible exposure levels (PEL). A secondary objective is to determine the genotoxicity of inhaled Gevo fuel by exposing rats for two weeks (10 exposure days) to Gevo fuel and quantifying the formation of micronuclei in bone marrow cells. The hypothesis is that the bio-derived Gevo fuel will have the equivalent or lesser degree of inhalation toxicity compared to JP-8 (i.e., mild effects on rats at the high dose exposure, minimal to no effects at the mid dose, and no effects at the low dose exposure).

IV. MILITARY RELEVANCE

The Tri-Services are pursuing a number of alternative fuels aimed at increasing domestic fuel production. One of the alternative fuels currently under consideration by the military is the bio-derived Gevo jet fuel, an alcohol-to-jet type of JP-8 generated from the conversion of alcohols to a synthetic fuel. This fuel is of interest for use by the Air Force, Army and Navy, and its certification process is being closely monitored by the Tri-Service Alternative Fuels Team. Fuels are among the most common sources of military occupational exposures. Inhalation is one of the primary routes of exposure; therefore, it is critical to study effects of fuel exposure on the lungs and its systemic effects on the body. The fuel is designed such that the chemical components are similar to JP-8, the traditional fuel of the Air Force. However, the overall composition is likely to be significantly different; therefore, health effects associated with exposure to the bio-based fuel may also differ from JP-8. The Air Force Research Laboratory Molecular Bioeffects Branch (AFRL/711 HPW/RHDJ) has been asked by the Air Force Research Laboratory Fuels Branch (AFRL/RQTF), the Alternative Fuels Certification Office (AFLCMC/WNN) and the Tri-Service Alternative Fuels Team to determine the potential health effects of the alternative fuel undergoing certification. In order to carry out the toxicity evaluation, AFRL/711 HPW/RHDJ enlisted the support of Naval Medical Research Unit Dayton (NAMRU-D). AFRL/711 HPW/RHDJ and NAMRU-D have designed a toxicity testing program for these alternative fuels, with recent agreement by the Tri-Service Alternative Fuels Team. The program includes specific toxicity tests required to develop a health hazard assessment for the fuel. A 90-day inhalation toxicity study of bio-derived Gevo fuel will be conducted to provide data to be used to establish occupational exposure limits for Department of Defense military and civilian personnel.

IV.1. Funding Agency

Air Force Life Cycle Management Center/Alternative Fuels Certification Office
(AFLCMC/WNN)

V. MATERIALS AND METHODS

V.1. Experimental Design and General Procedures

This study will be performed in two stages. Experiment 1 is a 90-day inhalation toxicity study of F344 rats to an aerosol and vapor mixture of Gevo fuel with neurotoxicity testing (see V.1.1. Experiment 1, below). Rats will be exposed 6 hours/day, 5 days/week, for approximately 13-15 weeks (minimum 65 exposure days) in whole-body chambers. Standard endpoints for a 90-day study include motor activity (MA) and functional observational battery (FOB) (to assess neurotoxicity), clinical chemistry and hematology of blood samples, and histopathology. Experiment 1 of this study will use 80 animals (10 rats per sex per exposure concentration). This is the minimum number of animals specified by the U.S. EPA OPPTS 870.3465 (90-Day Inhalation Toxicity) and OECD Test Guideline 413, Subchronic Inhalation Toxicity: 90-day Study, therefore the need for 80 animals is per specifications of these two guidelines.

The purpose of this study is to provide toxicity data associated with repeated inhalation of the test substance over a subchronic period of time (90-days). The results will provide data for determination of a no-observed effect level (NOEL) and toxic effects associated with repeated exposures over 90 days in order to develop a risk assessment for Gevo fuel. The 90-day inhalation study of FT jet fuel (Wong *et al.*, 2010; Mattie *et al.*, 2011) used a similar study design with 10 rats per sex per dose group (80 rats total).

Experiment 2 consists of a two-week inhalation exposure of F344 rats to an aerosol and vapor mixture of Gevo fuel (concurrent with Experiment 1) with a genotoxicity assay based on the U.S. EPA Health Effects Test Guidelines, OPPTS 870.5395, (Mammalian Erythrocyte Micronucleus Test) (see V.1.2. Experiment 2, below). These guidelines specify that there should be at least 5 analyzable animals per sex per treatment group and control group. For this study, 5 males and 5 females per exposure concentration (total of 40 animals) will be exposed to Gevo fuel. There will be an additional 10 males and 10 females, not exposed to jet fuel, for use as positive and vehicle controls, for a total of 60 animals for the micronucleus assay. The need for 60 animals to complete Experiment 2 is per the specifications of U.S. EPA Health Effects Test Guidelines, OPPTS 870.5395. These animals will be euthanized and dissected to extract bone marrow from the femur. The bone marrow will be processed and either stained and examined microscopically or analyzed by flow cytometry for micronuclei, an indicator of genotoxicity.

A summary of the animals required for the overall study is shown in Table 1.

TABLE 1: Study Summary

Group	Number of Animals	
	Males	Females
Experiment 1	40	40
Experiment 2	30	30
Total	70	70

V.1.1. Experiment 1

90-Day Inhalation Toxicity Study of Bio-Derived Gevo Jet Fuel in Rats (*Rattus norvegicus*) with Neurotoxicity Testing

Test Guideline:

This 90-day study design is based on the U.S. Environmental Protection Agency (U.S. EPA) Harmonized Test Guideline developed by the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) 870.3465, (90-Day Inhalation Toxicity). The neurotoxicity testing follows the U.S. EPA Health Effects Test Guideline OPPTS 870.6200 (Neurotoxicity Screening Battery).

Route, Duration and Frequency of Administration:

The test substance, Gevo Jet Blend Stock (jet fuel), will be administered as an aerosol/vapor combination. The inhalation route is one of the potential routes of human exposure to this test substance. The test subjects will be exposed for 6 hours per day, 5 days per week over a 13-week period (may be up to 15 weeks to allow for unforeseen delays or interruptions) to assess the hazards that might arise from repeated subchronic exposure to this material.

A staggered start of two replicates of animals will be required in order to complete the necropsy at the end of the study period. A total of 40 animals can be necropsied on a day, given the available personnel and facilities. In order to provide the same number of days of exposure, the total number of exposure animals will be divided into two replicates. The start of exposures for each replicate will be staggered by one day in order to stagger the necropsy days at the end of the study. A summary of the timeline is shown in Table 2.

TABLE 2: Experiment 1 Timeline

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
			Receive animals	Begin quarantine / facility acclimation			
						Quarantine release	
		Begin cage acclimation	Cage acclimation	Cage acclimation	Cage acclimation	Cage acclimation	
Wk 1		Exposure (Exp) Start Rep 1	Exp Continue Rep 1 and Start Rep 2	Exp	Exp	Exp	
Wk 2-8		Exp	Exp	Exp	Exp	Exp	
Wk 9		Exp	Exp VC	Exp VC	Exp VC	Exp VC	VC
Wk10	VC	Exp VC	Exp	Exp	Exp	Exp	
Wk 11-12		Exp	Exp	Exp	Exp	Exp	
Wk 13*		Exp	Exp	Exp	Exp (Rep 2) Rep 1 MA	Exp (Rep 1) Rep 2 MA	
Wk 14*		Exp	Exp	Exp	Exp (Rep 2) Rep 1 FOB	Exp (Rep 1) Rep 2 FOB	
Wk 15*		Exp	Last Exp Rep 1	Last Exp Rep 2 Necropsy Rep 1	Necropsy Rep 2		

* In case of holidays or missed exposure days

Rep: Replicate

VC: Vaginal cytology

MA: Motor activity

FOB: Functional observational battery

Exposure Levels:

Animals will be exposed to three concentrations of Gevo jet fuel, high (2000 mg/cubic meter), intermediate (700 mg/cubic meter) and low (200 mg/cubic meter), with a control group exposed to clean air (0 mg/cubic meter), as summarized in Table 3. These concentrations were selected based on results of previous 90-day inhalation studies with the chemically similar JP-8 jet fuel and FT synthetic jet fuel (see II.1. Background).

TABLE 3: Experiment 1 Summary

Group	Exposure Level	Number of Animals	
		Males	Females
Control Replicate 1	0	5	5
Control Replicate 2		5	5
Low Replicate 1	200	5	5
Low Replicate 2		5	5
Intermediate Replicate 1	700	5	5
Intermediate Replicate 2		5	5
High Replicate 1	2000	5	5
High Replicate 2		5	5
Total		40	40

Observations:

Animals will be observed before and after exposures for overt signs of toxicity. During necropsy, the tissues and organs will be examined for gross pathology. At necropsy, blood will be collected for clinical pathology measurements. Tissues will be collected for histopathology, including nasal airway, trachea, larynx, lungs, liver, kidneys, spleen, adrenals, heart, and others. Tissues in the control and high concentration group will be examined microscopically. If there are histopathological observations related to the exposure to the test substance, tissues from lower concentration groups may also be examined.

Motor Activity and Functional Observational Battery

A measure of motor activity (MA) and a functional observational battery (FOB) will be used to assess the neurotoxic effects of exposure to Gevo jet fuel vapor and aerosol.

Sperm Concentration, Motility and Morphology and Vaginal Cytology Examinations

In order to assess the potential reproductive toxicity of inhaled Gevo jet fuel, sperm concentration, motility and morphology and vaginal cytology examinations will be performed. Sperm from males at necropsy will be collected, stained, and examined for motility and percentage of abnormal sperm. The hormonal changes of the estrous cycle in female rodents are mirrored by changes in the predominance of cell type of the vaginal epithelium. Alterations in the estrous cycle of females will be assessed by examination of vaginal cytology from vaginal lavage samples collected daily from each female over a 7-day period (per NAMRU-D SOP 530-22). The rat estrous cycle lasts approximately 4-5 days and is characterized as proestrus, estrus, metestrus and diestrus. The stage of the cycle can be determined by the predominance of cell types in a vaginal smear or lavage sample. Proestrus is indicated by a predominance of nucleated round epithelial cells. Estrus is indicated by a predominance of irregularly shaped cornified epithelial cells in which the nucleus is not well-defined or is absent. Metestrus is

indicated by an approximately equal distribution of leukocytes, cornified epithelial cells and nucleated round epithelial cells. Diestrus is indicated by a predominance of leukocytes.

Selection for Study:

Animals considered suitable for study on the basis of pretest physical examinations, body weight data, and any other pretest evaluations such as the ophthalmologic exam, will be selected for this study. Body weights will be measured the day after arrival and prior to randomization for group assignment before beginning test substance exposure. During the acclimation period, animals will be randomly assigned to the groups in an attempt to equalize mean group body weights. Individual weights of animals placed on test will be within $\pm 20\%$ of the mean weight for each sex. Disposition of all animals not utilized in the study will be maintained in the study records.

Acclimation Period to Exposure Cages:

Animals will be acclimated to the facility for 7-10 days (see V.5.1) (Table 2). During the facility and cage acclimation periods, animals will be pair housed in solid bottom plastic cages. Towards the end of quarantine during the week prior to start of exposures, rats will be acclimated to the stainless steel wire-mesh cages (R-16, R-24 cage units or equivalent) in the animal room. Animals will be placed in the inhalation wire mesh cages for an increasing length of time, e.g. 1 hr, 2 hr, 3 hr, 4 hr, and then 6 hr on successive days, during which time the animals will not have access to food but will have access to water, *ad libitum*. Prior to assignment to study, all animals will be examined by an animal care staff member to ascertain suitability for study.

Test Substance and Route of Administration:

The test substance, Gevo fuel, will be administered as an aerosol/vapor combination by inhalation in whole-body exposure as this is a major potential route of human exposure to this test substance. The properties of Gevo are summarized in Table 4.

TABLE 4: Test Substance

Name:	IBF002 Gevo Jet Blend Stock
CAS #:	NA (mixture)
Formula:	NA (mixture)
Major components:	2,2,4,4,6-pentamethylheptane
	2,2,4,6,6-pentamethylheptane
	2,2,4,4,6,8,8-heptamethylnonane
	2,2,4,4,6,6,8-heptamethylnonane
Molecular Weight	NA, mixture
Description:	Colorless to slight yellow liquid
Test Substance Category:	Fuels. Jet Aircraft. OSHA Flammability Class Combustible Liquid.
Storage:	Keep container closed tightly in cool, well-ventilated place. Keep away from heat, and sources of ignition.
Stability:	Stable at normal conditions. Decomposes upon heating.
Supplier:	Gevo through AFRL Fuels Branch (AFRL/RQTF)
Lot Number:	POSF 10262 with JP-8 additives

Expiration date: One year from date of receipt.

Frequency and Duration of Administration:

The test substance will be administered for 6 hours per exposure day, 5 days per week for a total of at least 65 exposures. The number of consecutive non-exposure days will not exceed two with exceptions for facility holidays, FOB and MA assessments, severe weather, or other events which may preclude safe operation of the exposures. There will be at least 65 exposure days, but may be up to 75 days to allow for specified number of exposure days before events such as FOB, MA, or necropsy. To accommodate the numbers of animals in the FOB tests and at the terminal necropsy, animals will be divided into two replicate groups. The exposure start, FOB test day, and terminal necropsy day for the two groups will be staggered by a day. In order to provide consistent dosing conditions prior to neurobehavioral testing, both replicates will be exposed for the same number of days prior to FOB testing.

Generation of Test Substance:

The test substance will be administered as an aerosol and vapor combination in the breathing air of the animals. The test atmosphere will be generated by a spray nozzle using procedures developed during pre-study trials and similar to those used for previous 2-day, two-week, 90-day, and other jet fuel studies conducted in Building 837. Trials will be performed to evaluate the optimal set of conditions and equipment to generate a stable atmosphere at the target exposure levels. The method will be described in the raw data of the study and in the report.

Exposure System:

Rats will be exposed by inhalation in 1-cubic meter stainless steel and glass whole body exposure chambers (H1000, Lab Products, Inc., Seaford, DE) located in room 265 of Building 837. One chamber will be used per dose group. Each chamber holds up to 3 stainless steel wire mesh cages and each cage can individually house up to 16 or 24 rats (R-16 or R-24, respectively, Lab Products, Inc., Seaford, DE). The 1-cubic meter exposure chambers will be operated at a flow rate of approximately 225L/min to provide at least one complete air change in 4.4 minutes (13.5 air changes/hour; minimum guideline requirements are 10 air changes per hour) and a T₉₉ equilibrium time of approximately 20.5 minutes (T₉₉ is the time for the concentration of test substance in the chamber to rise from background or zero to 99% of the equilibrium or target concentration). This chamber size and airflow rate is considered adequate to maintain an oxygen level that is at least 19%, the minimum required by the guidelines. At the end of an exposure, the chamber will be operated at approximately the same, or higher, flow rate using clean air. All animals will remain in the chamber for typically 30 minutes (but a minimum of the T₉₉ equilibrium time), so that the bulk of the test material is cleared from the chamber. To minimize exposure to off-gassed test material, rats in the control chamber will be transferred from the chamber to their domiciliary caging and returned to the animal housing room in the vivarium prior to removing the test material exposed rats from their chambers. The test material-exposed rats will be held in a different animal room from the control rats to minimize exposure of the control animals to any off-gassing from the exposed rats. During the exposure period in Building 837, rats will not have access to food, but will have access to water, *ad libitum*. All rats will be moved to an animal housing room in Building 838 during non-exposure periods.

Monitoring of Test Substance Concentration:

A nominal exposure concentration will be calculated. The flow of air through the chamber will be monitored using appropriate, calibrated equipment. The test substance consumed during the exposure and the total volume of air passing through the chamber (volumetric flow rate times total exposure time) will be used to calculate the nominal concentration.

During the exposure, measurements of airborne concentrations will be performed in the animals' breathing zone. Aerosol concentration will be measured using a gravimetric filter or equivalent method. Vapor concentration will be measured using an appropriate sampling procedure and analytical method (Fourier Transform Infrared Spectrophotometry (FTIR, Nicolet 380, ThermoScientific, or equivalent). The analytical method will be developed in the pre-study trials and documented in the study file.

Particle Size Distribution:

Particle size distribution measurement will be performed using an appropriate particle size instrument such as cascade impactor (7-stage, In-Tox Products, Moriarity, NM, or equivalent) or an optical particle size spectrometer (Aerodynamic Particle Sizer (APS) Model 3321, TSI, Inc., Shoreview, MN, or equivalent).

Uniformity:

The distribution of material within the chamber will be checked for uniformity prior to the start of exposures. Measurements of concentration will be taken at 9 port locations under steady generation conditions.

Monitoring of Environmental Conditions:

Chamber temperature, humidity, airflow rate, and static pressure will be monitored continuously and recorded at least three times during the exposure. Chamber temperature and relative humidity will be maintained, to the maximum extent possible, between 20 to 24°C and 30 to 70%, respectively. Temperature and relative humidity will be monitored and if levels fall outside of the reference range, the Attending Veterinarian will be notified to assess the animals for any adverse effects.

The minimum frequency of chamber monitoring activity is summarized in Table 5.

TABLE 5: Summary of Chamber Monitoring Activities

Activity	Minimum Frequency per chamber
Measured Test Substance Concentration	3 times per day
Aerosol concentration and size distribution	1 time per week
Temperature	3 times per day
Relative Humidity	3 times per day
Airflow Rate	3 times per day
Static Pressure	3 times per day
Nominal Test Substance Concentration (excluding the air control chamber)	1 time per day

Postmortem Observations:**Moribund and Humane Euthanasia**

Animals showing signs of severe debility, particularly if death appears imminent, will be euthanized to prevent unnecessary suffering or loss of tissues through autolysis. Necropsy should be performed immediately. If a necropsy cannot be performed on a euthanized animal or an animal found dead, the animal should be refrigerated to minimize autolysis. Necropsy should be performed within two days, if possible.

Terminal Euthanasia and Necropsy

Euthanasia and necropsy of all surviving animals will be performed on the day after the last scheduled exposure. Animals will not be provided food between the final exposure and euthanasia. Final body weights will be collected prior to euthanizing the animals.

V.1.2. Experiment 2

Two-week Inhalation Genotoxicity Study of Bio-Derived Gevo Jet Fuel in Rats (*Rattus norvegicus*) Using Bone Marrow Micronucleus Assay

Test Guideline:

This genotoxicity study is based on the U.S. Environmental Protection Agency (U.S. EPA) Harmonized Test Guideline developed by the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) 870.5395, (Mammalian Erythrocyte Micronucleus Test).

Concurrently with Experiment 1 (V.1.1.), animals (5 males and 5 females per exposure concentration, total of 40 animals) will be exposed to the same concentrations of Gevo fuel for approximately 2 weeks (10 exposures) for a bone marrow micronucleus assay to assess potential genotoxicity. There will be an additional 10 males and 10 females, not exposed to jet fuel for use as positive and vehicle controls, for a total of 60 animals for the micronucleus assay (summarized in Table 6). Animals in the micronucleus study will be euthanized by an approved method, and dissected to remove the femur. The bone marrow will be processed and stained and then examined either microscopically or by flow cytometry.

Table 6: Two-week Inhalation of Bio-Derived Gevo Jet Fuel in Rats (*Rattus norvegicus*) with Genotoxicity Assay

Group	Exposure Level	Number of Animals	
		Males	Females
	mg/cubic meter		
Control	0	5	5
Low	200	5	5
Intermediate	700	5	5
High	2000	5	5
Negative Control	Saline	5	5
Positive Control	CP	5	5
Total		30	30

Negative and Positive Controls:

Concurrent negative control (physiological saline) and positive control (cyclophosphamide [CP], a known and recommended micronucleus inducer, per OECD Test Guideline 474: Mammalian Erythrocyte Micronucleus Test) groups will be included in the study. Animals in the negative control group will be used for the measurement of background frequency of micronucleated cells. Physiological saline at 1 ml per 100 g bodyweight will be given by IP injection, approximately 24 hours before animal euthanasia and necropsy.

The positive control will be used to verify the responsiveness of the test system. A solution of CP in physiological saline will be prepared at 4 mg/ml. Based on the animal weight, the CP solution will be administered by IP injection at 1 ml/100 g body weight, to give a dose of CP of 40 mg / kg animal body weight, approximately 24 hours before animal euthanasia and necropsy. Animals used for negative and positive controls in the micronucleus assay will be euthanized as in section V.4.6.

Micronuclei Evaluation:

Sample Processing

After euthanasia, animals on the micronucleus study will not undergo a full necropsy, but will have the femur removed. Bone marrow will be isolated by flushing the femur with 1 ml of heat-inactivated fetal bovine serum (FBS) into ice-cold 100% methanol fixative. Bone marrow cells will then be stained and analyzed according to the manufacturer's instructions (MicroFlow Plus RBM, Litron Laboratories, Rochester NY) by flow cytometry.

Micronuclei Observation

The frequency of micronucleated cells will be observed by flow cytometry from 20,000 reticulocytes per animal. The percentage of reticulocytes (%RET), micronucleated mature normochromatic erythrocytes (%MN-NCE), and micronucleated reticulocytes (%MN-RET) will be determined per animal. The results of the micronucleus assay can be considered positive if there is: a clear dose-related increase in the number of micronucleated reticulocytes; or a reproducible and statistically significant increase in the micronucleated reticulocyte frequency is detected for at least one concentration of the test substance; and a statistically significant difference in the micronucleated reticulocyte frequency between the positive and negative control.

V.2. Data Analysis

V.2.1 In-Life and Postmortem Observation Statistics

The following items will be analyzed statistically in the final report (for male versus females) and control rats versus treated: daily feed consumption and weekly mean body weight values and body weight changes (from pretest) will be analyzed from In-Life Observations and hematology, coagulation, clinical chemistry, and organ weights from Postmortem Observations.

Evaluation of equality of group means will be made by the appropriate statistical method, followed by a multiple comparison test if needed. Bartlett's (Bartlett, 1937) or Levene's test (Levene, 1960) will be performed to determine if groups have equal variances. Shapiro-Wilk test will be used to determine if data are from a normally distributed population (Shapiro and Wilk, 1965). If variances are equal and from a normally distributed population, a standard one-way analysis of variance (ANOVA) will be used to assess significance. If variances are unequal, Welch's ANOVA will be used (Sokal and Rohlf, 1995). If significant differences among the means are indicated, additional tests will be used to determine which means are significantly different from the control: Dunnett's (Dunnett, 1955, 1964), Williams (Williams, 1971, 1972), or Cochran and Cox's modified t-test (Cochran and Cox, 1959). If data are non-normal, nonparametric methods such as Kruskal-Wallis test (Kruskal and Wallis, 1952, 1953) will be used and if differences are indicated, Shirley's test (Shirley, 1977; Williams, 1986) or Steel's test (Steel, 1959) will be used to determine which means differed from control. Bartlett's or Levene's test for equality of variance will be conducted at the 1% significance level; all other statistical tests will be conducted at the 5% significance levels.

V.2.2. Motor Activity and FOB

For neurobehavioral assessments, the data for quantitative, continuous variables will be compared for the exposure and control groups by tests for homogeneity of variance, 2-way fixed effects (dose and sex) analysis of variance (ANOVA), and Dunnett's multiple comparison procedure for significant ANOVAs. If the ANOVA indicates statistical significance among experimental groups, the Dunnett's test will be used to delineate which groups differ from the control group. A natural log transformation of the data will be used if the Levene's test indicates that the data are non-homogeneous. In the event that the Levene's test on the transformed data indicates non-homogeneous data, Welch's test will be used. A nested analysis of motor activity data will be performed using a repeated measures analysis with exposure as a grouping factor and interval as a within-subject factor. Additional exposure group comparisons of total cumulative test session activity will be performed. Incidence data will be compared using the appropriate statistical test, generally Fisher's Exact test. Incidence data for selected FOB endpoints with ordered severity scores will be analyzed for group differences using appropriate measures of association. Statistical analyses will be performed using either SAS or JMP statistical software or other statistical programs, as deemed appropriate. The probability value of less than 5% will be used as the critical level of significance for each statistical test, except that the critical level of significance for Levene's test for homogeneity of variance will be less than 1%. All other uncorrected probability values of less than 5% will be listed in the report.

V.3. Laboratory Animals Required and Justification

V.3.1. Non-animal Alternatives Considered

There are still no adequate non-animal alternatives to *in vivo* inhalation studies. Toxicity assessments in cell culture lines to eliminate or reduce the use of animals exposed by inhalation have been conducted by various researchers. However, there is still little correlation between *in vitro* and *in vivo* studies of lung toxicity (Sayes *et al.*, 2007). Living animal models must still be

used due to the complex nature of the lungs and potential systemic effects following exposure via inhalation.

V.3.1.1. Literature Search for Alternatives to Animal Use

V.3.1.2. Databases Searched

Johns Hopkins Center for Alternatives to Animal Testing (Altweb), AGRICOLA, PubMed, BIOSIS, Animal Welfare Information Center (AWIC) web site and Center for Alternatives to Animal Testing (CAAT). Toxline, Toxfile, Federal Research in Progress (FEDRIP), DTIC technical reports and research summaries, Biomedical Research Database (BRD).

V.3.1.3. Number, Date, and Resources of Search

Search # 2013164 was completed 2/20/2013 by Ms. Michelle Burwinkel, MLS, DO-I of the D'Azzo Research Library, AFRL/RQWC

V.3.1.4. Period of Search

All dates to present.

V.3.1.5. Key Words of Search

Alternatives, rat, mouse/mice, micronucleus, inhalation, two-week, 90-day, subchronic, 13-week, sensory irritation (in lungs = respiratory tract), RD50, Alarie test, *in vitro*, cell culture plus jet fuel, bio-derived Gevo, Gevo Jet Blend Stock, ATJ, alcohol-to-jet, ATJ ethanol, ATJ butanol, ATJ isobutanol, ATJ cellulosic alcohol, biofuel, biobased/bio-based, invertebrate, culture, model, artificial, species, computer

V.3.1.6. Results of Search

The current literature search did not yield any alternative non-animal models that could take the place of the animal inhalation study. As inhalation studies are complex and rely on systemic responses, existing alternative models are not suitable to establish potential systemic toxicity. While there are advancing *in vitro* methods that aim to better identify toxicity associated with individual tissues, appropriate and validated *in vitro* models are still lacking. Even on a single tissue level, a study has attempted to correlate *in vivo* mouse inhalation exposures to JP-8 with *in vitro* rat lung slices exposed to JP-8 in cell culture medium (Hays *et al.*, 2003). The *in vitro* study was not conducted concurrently with the *in vivo* study; therefore, similar cellular pathology seen between the two studies was a qualitative correlation. The study was not proposed as a substitute for an *in vivo* inhalation study. Additionally, it is not possible to extrapolate no-effect doses to humans in order to establish occupational exposure levels. Currently, there is still little correlation between *in vitro* and *in vivo* studies of lung toxicity (Sayes *et al.*, 2007).

V.3.2. Animal Model and Species Justification

The rat is used as a surrogate model for humans in the detection of toxicity to establish occupational exposure levels. This rodent species is recommended for inhalation toxicity as directed by the U.S. EPA, Health Effects Test Guidelines, OPPTS 870.3465 (90-day Inhalation Toxicity) and is preferred by the OECD Test Guideline 413 (Subchronic Inhalation Toxicity: 90-day Study). This study also follows the U.S. EPA Health Effects Test Guideline OPPTS 870.6200 (Neurotoxicity Screening Battery) which recommends the laboratory rat as the species of choice. Experiment 2 (see V.1.2.) follows the U.S. EPA Health Effects Test Guidelines OPPTS 870.5395 (Mammalian Erythrocyte Micronucleus Test). This guideline recommends mice or rats, or any appropriate mammalian species. The experimental design for this protocol uses a rat model in the procedures and standards required by the current federal and international regulations. Historical control data are also available with this strain of rat for comparative evaluation.

V.3.3. Laboratory Animals

V.3.3.1. Genus / Species

Rattus norvegicus

V.3.3.2. Strain / Stock

Fischer 344

V.3.3.3. Source / Vendor

Charles River Laboratories, Wilmington, MA

V.3.3.4. Age

At receipt: Approximately 6 weeks

At start of exposures: Approximately 8-9 weeks

V.3.3.5. Weight

Age appropriate

V.3.3.6. Sex

Males and females will be studied to determine if any observed effects are sensitive or specific to gender.

V.3.3.7. Special Considerations

Females will be nulliparous and nonpregnant.

V.3.4. Number of Animals Required (by Species)

Rats: 140 (70 males, 70 females)

V.3.5. Refinement, Reduction, Replacement (3 R's):

V.3.5.1. Refinement

The procedures used in this study were developed and refined by EPA scientists and non-EPA scientists with particular interests and/or expertise in inhalation toxicology studies and issued in OPPTS 870.3465: 90-day Inhalation Toxicity. The EPA has a process to revise guidelines if changes are needed and the currently published guidelines are being used for this study. These guidelines were also harmonized with OECD Test Guideline 413, Subchronic Inhalation Toxicity: 90-Day Study, established by the Organization for Economic Cooperation and Development (OECD), an international organization composed of industrial nations with similar testing requirements for industrial chemicals.

The OECD Test Guideline 413 does consider that when exposing animals to materials, the targeted concentrations should be low enough as to not cause marked pain and distress, while still being sufficient to yield regulatory and scientific objective of the study. Additionally, these guidelines also consider that animals should be closely observed and moribund animals or animals obviously in pain or showing signs of severe and enduring distress should be euthanized.

The EPA guidelines do not specify a cage acclimation process, however the OECD guidelines suggest that the animals be placed in their exposure cages for at least 5 days prior to the start of the test to allow for acclimatization to the laboratory conditions. As such, rats will be acclimated to stainless steel wire-mesh cages by placing them in the inhalation wire mesh cages for increasing length of time over 5 days in order to reduce distress during exposure (see V.1.1. Experiment 1 Acclimation Period to Exposure Cages). Enrichment items (e.g., nylabones) may be provided in domiciliary cages as enrichment tools to alleviate distress.

V.3.5.2. Reduction

The number of animals selected is the minimum required to satisfy regulatory guidelines. We have added additional parameters for reproductive, neurobehavioral, and genotoxicity endpoints to expand the screening ability of this study. If these additional endpoints are negative, we will have eliminated the need for two additional animal studies.

V.3.5.3. Replacement

Currently there is no *in vitro* system that can substitute for an animal inhalation model. There are no non-animal systems capable of addressing the research questions being asked in this protocol. There is still little correlation between *in vitro* and *in vivo* studies of lung toxicity (Sayes *et al.*, 2007). Non-mammalian systems, such as fish or amphibians, are also unsuitable models as respiratory toxicology is strongly linked to respiratory physiology. The anatomical

structure of the lung with the physiology of breathing used to bring inhaled air into the lungs causes specific patterns of deposition and interaction within respiratory tissue. This cannot be replicated in a water environment with fish, and the lung anatomy and interaction with inhaled air is sufficiently different in amphibians as to be a poor model for human inhalation studies. Animal systems, specifically the rat, are necessary for determining the repeated inhalation effect of Gevo fuel on the respiratory system.

V.4. Technical Methods

V.4.1. Pain / Distress Assessment

V.4.1.1. APHIS Form 7023 Information

V.4.1.1.1. Number of Animals

	Animal Species, Strain, and/or Stock	Number per USDA Pain Category			
		C	D	E	Total
Number of Animals/Pain Category Requested in this Protocol:	<i>Rat, Fischer 344</i>		140		140

V.4.1.2. Pain Relief / Prevention

V.4.1.2.1. Anesthesia / Analgesia / Tranquilization

Rats will be deeply anesthetized with a ketamine/xylazine cocktail (intraperitoneal injection, at 40-80 mg/kg ketamine and 5-8 mg/kg xylazine), using a 1 ml syringe with a 20-23 gauge needle) before any invasive procedure, as needed to achieve appropriate level of anesthetization. Pain alleviation of anesthetized animals will be determined by testing the toe pinch reflex. When a rat is no longer responsive to toe pinch it will be considered adequately anesthetized.

V.4.1.2.2. Pre- and Post-procedural Provisions

The PI will notify the Attending Veterinarian, at least one week in advance, of all procedures that require the use of anesthesia to ensure the Attending Veterinarian's availability in the event he/she is needed.

Viability Checks

Animals will be observed for morbidity, mortality, general appearance, and signs of severe toxic or pharmacological effects before and after exposures on exposure days by the inhalation staff. Animals will be observed twice daily for signs of distress and the observations will be recorded by RSC staff. Animals will be observed at least once during the day during non-exposure periods by the RSC staff. See section V.5.2.1.

Clinical Observations

Each animal will be examined at least twice pre-exposure, and on the day of each exposure, and prior to euthanasia. Examinations will include observations of general condition, skin and fur, eyes, nose, oral cavity, abdomen and external genitalia as well as evaluations of respiration, circulatory effects, autonomic effects, central nervous system effects, and reactivity to handling or sensory stimuli.

Display of a physical condition or state that suggests consideration of euthanasia before the study endpoints have been developed by the Organization of Economic Cooperation and Development (OECD) (2000) and are also referenced in WPAFB IACUC Policy 01-06. The OECD clinical signs to be used as early study endpoints are listed below:

- abnormal vocalization
- abnormal aggressiveness
- abnormal reaction to handling
- abnormal external appearance (i.e., ruffled fur indicating lack of grooming, dried urine and/or feces near anogenital area)
- prolonged, impaired ambulation preventing the animal from reaching food or water, or prolonged anorexia
- excessive weight loss and/or extreme emaciation and/or severe dehydration
- evidence to suggest irreversible organ failure
- prolonged absence of voluntary responses to external stimuli
- persistent, difficult labored breathing
- prolonged inability to remain upright
- persistent convulsions
- self-mutilation, open wounds, or skin ulceration
- prolonged diarrhea

Animals consistently displaying one or more of these signs will be immediately removed from the study (i.e., euthanized). Persons (RSC and NAMRU–Dayton staff) observing any animals displaying the indicated clinical signs will immediately inform the study PI. The PI will authorize NAMRU–Dayton or RSC staff to euthanize the animal. During off-duty hours, if the PI is not able to be contacted via phone or email, the PI authorizes the RSC staff, at the discretion of the Attending Veterinarian, to euthanize any animal that is found moribund or appears to be in intense, unrelievable pain. The carcass of the animal will be placed in a plastic bag along with its cage card. The bag will then be placed in the walk-in refrigerator in Necropsy, Room 67, Bldg 838. The RSC staff will then alert the PI by email as to the final condition of the animal and the animal number on the cage card.

V.4.1.2.3. Paralytics

N/A

V.4.1.3. Literature Search for Alternatives to Painful or Distressful Procedures

V.4.1.3.1. Databases Searched

Johns Hopkins Center for Alternatives to Animal Testing (Altweb), AGRICOLA, PubMed, BIOSIS, Animal Welfare Information Center (AWIC) web site and Center for Alternatives to Animal Testing (CAAT). Toxline, Toxfile, Federal Research in Progress (FEDRIP), DTIC technical reports and research summaries, Biomedical Research Database (BRD).

V.4.1.3.2. Number, Date, and Resources of Search

Search # 2013163 was completed 2/20/2013 by Ms. Michelle Burwinkel, MLS, DO-I of the D'Azzo Research Library, AFRL/RQWC.

V.4.1.3.3. Period of Search

All dates to present.

V.4.1.3.4. Key Words of Search

Pain, alternatives, distress, rat, mouse/mice, micronucleus, inhalation, two-week, 90-day, subchronic, 13-week, sensory irritation (in lungs = respiratory tract), RD50, Alarie test, *in vitro*, cell culture plus jet fuel, bio-derived Gevo, Gevo Jet Blend Stock, ATJ, alcohol-to-jet, ATJ ethanol, ATJ butanol, ATJ isobutanol, ATJ cellulosic alcohol, biofuel, biobased/bio-based

V.4.1.3.5. Results of Search

The literature search did not yield any alternatives to the 13-week inhalation study. The procedures used during the 90-day inhalation study do not typically result in or produce pain or distress; there is only the potential for pain if the test agent produces significant irritation.

V.4.1.4. Unalleviated Painful or Distressful Procedure Justification

N/A

V.4.2. Prolonged Restraint

N/A

V.4.3. Surgery

V.4.3.1. Pre-surgical Provisions

Rats will be will be deeply anesthetized with a ketamine/xylazine cocktail (intraperitoneal injection, at 40-80 mg/kg ketamine and 5-8 mg/kg xylazine), using a 1 ml syringe with a 20-23

gauge. Terminal surgery will be performed using surgical gloves, mask, and clean instruments. Needles and syringes will not be treated with an anticoagulant.

V.4.3.2. Procedure(s)

Following anesthesia per section V.4.1.2.1, the abdomen will be opened with scissors, the diaphragm will be cut (to create a pneumothorax), the intestines moved to one side, and blood for clinical pathology will be drawn from the caudal vena cava or heart using a 1 or 10 mL syringe with a 18-23 gauge, ½-1” needle. Needles and syringes will not be treated with an anticoagulant. After blood collection is complete, the abdominal aorta will be transected for terminal exsanguination (i.e., euthanasia) prior to tissue harvest.

V.4.3.3. Post-surgical Provisions

The surgical procedure is terminal.

V.4.3.4. Location

Anesthesia, euthanasia, and tissue harvest will be performed in the RSC, Room 67, Building 838. Behavioral observations will take place in Room 259 or 269 of Building 837.

V.4.3.5. Surgeon

Trained personnel with experience in these activities may perform the terminal surgery procedures. All inexperienced personnel will be supervised and trained by senior, experienced protocol personnel and/or RSC staff.

V.4.3.6. Multiple Major Survival Operative Procedures

V.4.3.6.1. Procedures

None

V.4.3.6.2 Scientific Justification

N/A

V.4.4. Animal Manipulations

V.4.4.1. Injections

In Experiment 2, animals in the negative and positive control groups will be administered either physiological saline (1 ml per 100 g body weight) or cyclophosphamide (CP) in physiological saline (4 mg/ml, 40 mg / kg animal body weight) by intraperitoneal injection. Each animal will receive a single injection using a 20-23 gauge needle.

Intraperitoneal injections of ketamine/xylazine are part of the euthanasia procedure (See Section V.4.6). No other injections are planned. Blood will be drawn from the caudal vena cava or heart using a 1 or 10 mL syringe with a 18-23 gauge ½-1” needle. Needles and syringes will not be treated with an anticoagulant.

V.4.4.2. Biosamples

Following anesthesia and surgery as described in sections V.4.1.2.1 and V.4.3, 3-5 mL of blood will be collected from the caudal vena cava or heart using a 1 or 10 ml syringe with a 18-23 gauge, ½-1” needle. Needles and syringes will not be treated with an anticoagulant.

V.4.4.3. Adjuvants

N/A

V.4.4.4. Monoclonal Antibody (MAb) Production

N/A

V.4.4.5. Animal Identification

Each animal will be assigned a temporary identification number and cage location upon receipt. After selection for study, each animal will be identified by tail tattoo with a number assigned by the Testing Facility. The study number plus the number assigned by the Testing Facility will comprise the unique animal number for each animal. A cage assignment chart will indicate cage assignment by the animal identification number. Animals used in FOB testing will be assigned a temporary identification number by cage cards for the purpose of keeping the observers blind to treatment given.

V.4.4.6. Behavioral Studies

Formal observation of animal behavior as described above for motor activity and functional observational battery (NAMRU-D SOP 510-01) are specified endpoints for this study. The U.S. EPA Health Effects Test Guideline OPPTS 870.6200 (Neurotoxicity Screening Battery) describes the specific observations to be made. These endpoints are intended to identify unusual or abnormal behavior that may indicate potential neurotoxic effects caused by the inhalation of Gevo fuel.

V.4.4.7. Other Procedures

In-Life Evaluation Observations:

Viability Checks

Animals will be observed for morbidity, mortality, general appearance, and signs of severe toxic or pharmacological effects before and after exposures on exposure days by NAMRU-D

personnel. Animals will be observed at least once during the day during non-exposure periods by RSC staff. Animals in extremely poor health or in a possible moribund condition will be identified for further monitoring and possible euthanasia.

Clinical Observations

Each animal will be examined at least twice pre-exposure, on the first day of exposure or one day prior and weekly during the exposure regimen by trained NAMRU-D personnel by (or under the direct supervision of) trained NAMRU-D personnel. Clinical observations will be recorded on scheduled body weight collection days. Examinations will include observations of general condition, skin and fur, eyes, nose, oral cavity, abdomen and external genitalia as well as evaluations of respiration, circulatory effects, autonomic effects, central nervous system effects, and reactivity to handling or sensory stimuli.

Ophthalmologic Examination

Ophthalmological examinations performed by the Attending Veterinarian will be made on all animals prior to the administration of test substance and on high Gevo concentration (2000 mg/cubic meter) and control groups at termination. If changes in the eyes are detected, all animals in the other jet fuel concentration groups will be examined.

Body Weight and Food Consumption

Body weights will be recorded the day after arrival, at randomization, and daily prior to exposure and at necropsy by trained NAMRU-D personnel. Corresponding food consumption will be evaluated by measuring feed weight daily while animals are being exposed.

Vaginal Cytology

After at least 6 weeks of exposure, vaginal lavage will be performed for each female rat for 7 consecutive days (5 exposure days and 2 non-exposure days) to determine changes to the female rat estrous cycle by vaginal cytology, in accordance with the enclosed NAMRU-D SOP 530-22 and by (or under the direct supervision of) trained personnel with reproductive/developmental research and vaginal lavage experience. Vaginal lavage will be performed prior to the start of each day's exposure for exposure days, and at the approximate same time of day on non-exposure days. Briefly, a pipette with a disposable tip will be used. The pipette will be used to draw approximately 25 µL of sterile water or saline into the tip, the tip will be placed into the vaginal opening of the rat, and the fluid will be expelled into the vagina and then re-collected using the pipette. A glass slide will be divided into 8 approximately equal squares by drawing solid lines with a grease pencil onto the slide surface. The first square will contain the animal number (unless the slide has a label on which this information is placed) and the other squares will be used in consecutive order moving from left to right across the top 4 squares and then moving down to the second row and moving from left to right across the bottom 4 squares. A large drop of vaginal lavage fluid will be placed into the appropriate square for that day on the slide and allowed to dry, with all 7 days of smears placed onto the same slide for each individual animal. The vaginal smears collected over the week and allowed to dry will then be stained with

methyl blue. Slides will be examined under a microscope at moderate magnification to allow identification of the types of vaginal cells present. The predominance of any one specific type of cell is representative of a stage of the estrous cycle. Proestrus is indicated by a predominance of nucleated round epithelial cells. Estrus is indicated by a predominance of irregularly shaped cornified epithelial cells in which the nucleus is not well-defined or is absent. Metestrus is indicated by an approximately equal distribution of leukocytes, cornified epithelial cells and nucleated round epithelial cells. Diestrus is indicated by a predominance of leukocytes.

Motor Activity

After at least 11 weeks of exposure, on a non-exposure day following at least 3 consecutive days of exposure, animals from one replicate group will be transferred into a neurotoxicology laboratory. The second replicate group will be transferred the next day. Animals will undergo motor activity assessment, performed in accordance with the enclosed NAMRU-D SOP 510-04 and by (or under the direct supervision of) trained personnel with neurobehavioral research experience. Briefly, animals will be placed into standard clear polycarbonate cages and spontaneous motor activity will be determined using an automated photobeam data collection system. Photobeams will record both fine movements (one photobeam broken) and ambulations (two photobeams broken in sequence). Data will be automatically collected by a computer system. Efforts will be made to control conditions that can affect behavior including sound level, temperature, humidity, lighting, odors, time of day, and environmental distractions. Tests will be performed under reduced lighting conditions and with an approximately 70 dB white noise background to minimize disruption resulting from extraneous noise. A test session for most adult rats is anticipated to last for one hour in duration, and motor activity will be determined over individual 6 minute intervals.

Functional Observational Battery

After 12 weeks of exposure, on a non-exposure day following at least 3 consecutive days of exposure, animals from one replicate group will be transferred into a neurotoxicology laboratory. The second replicate group will be transferred the next day. A functional observational battery (FOB) consists of non-invasive procedures designed to evaluate and document the absence or presence (or severity, if appropriate) of a predetermined set of behavioral and clinical signs. These procedures will be performed in accordance with the enclosed NAMRU-D SOP 510-01 and by (or under the direct supervision of) trained personnel with neurobehavioral research experience. Typically, observations are made 1) while the rat is in an observation cage, 2) during removal of the rat from the observation cage, 3) while the rat is being held and examined for clinical observations, 4) as the animal moves freely about the open field, and 5) during manipulative tests. Typically, the observations proceed from the least to most manipulative tests to reduce the influence of handling on the rat's behavior. Efforts will be made to control conditions that can affect behavior including sound level, temperature, humidity, lighting, odors, time of day, and environmental distractions.

The FOB includes, but is not limited to, the following observations, made and recorded in study records:

- In cage observations: Posture, tremors and spasms, and palpebral closure.

- Observations during removal from cage and handling: reactivity to handling, muscle tone, lacrimation, salivation, fur appearance, facial crust, breathing pattern, and other clinical signs.
- Open field observations: arousal and activity level, gait, body position, vocalization, tremor, spasm, unusual behaviors, urination and defecation count.
- Manipulative observations:
 - approach response: response to a blunt object approaching and stopping before the animal's nose.
 - acoustic response: response to a hidden metallic click.
 - tail pinch response: response to a pinch of the tail.
 - visual placement: response of forelimb to grasp for a surface while being held by the observer.
 - surface righting: righting response to being turned and briefly held on its back.
 - hind leg splay: response to being dropped approximately 30 cm (12 inches). Hind legs are painted to mark the location of the hind legs upon landing. This test is not done if the animal is judged too weak to support its weight when dropped or if righting response is not displayed.
 - grip strength: force necessary to break the animal's grip on a wire mesh.
 - pupillary light reflex: pupil response to light.
 - body weight (if not weighed earlier on the day of the FOB evaluation).

V.4.4.8. Tissue Sharing

Tissues not needed for data analysis will be made available to WPAFB researchers upon request.

V.4.5. Study Endpoint

The endpoint for all animals in this study will be euthanasia as described in section V.4.6.

V.4.6. Euthanasia

Following deep anesthesia as described in section V.4.1.2.1, the abdomen will be opened with scissors, the diaphragm will be cut (to create a pneumothorax), the intestines moved to one side, and blood will be drawn from the caudal vena cava or heart using a 1 or 10 mL syringe with a 18-23 gauge, ½-1" needle. Following blood collection, the abdominal aorta will be transected for terminal exsanguination prior to tissue harvest. Euthanasia will occur by exsanguination.

V.5. Veterinary Care

V.5.1. Husbandry Considerations

Upon arrival at Bldg 838, WPAFB Area B, animals will be housed, fed, and watered in accordance with RSC SOP 603. New animals will be segregated from the current population for a quarantine and acclimation period of 7 to 10 days. All animals with evidence of disease or physical abnormalities will be euthanized and necropsied. If an unusually large number of animals show evidence of disease or physical abnormalities, the entire shipment of animals will

be rejected for use in the study. During the facility acclimation period, animals will be pair housed (for enrichment purposes) in solid bottom plastic cages. During cage acclimation, the rats will be individually housed within wire-mesh cages during the 1 to 6 h cage acclimation period and pair housed upon return to their domiciliary caging. Following facility and cage acclimation, rats will be individually housed at all times. Rats will be individually housed during exposure in wire mesh cages to prevent huddling and during non-exposure periods in order to monitor food consumption. Towards the end of quarantine during the week prior to start of exposures, rats will be acclimated to the stainless steel wire-mesh cages (R-16, R-24 cage units or equivalent) in the animal room. Animals will be placed in the inhalation wire mesh cages for an increasing length of time, e.g. 1 hr, 2 hr, 3 hr, 4 hr, and then 6 hr on successive days, during which time the animals will not have access to food, but will have access to water *ad libitum*. Prior to assignment to study, all animals will be examined by an animal care staff member to ascertain suitability for study.

Animal rooms will be maintained at a temperature and relative humidity in accordance with the recommendations of the NRC's *Guide for the Care and Use of Laboratory Animals*, with approximately 15 complete air changes per hour, and a 12hr:12hr electronically controlled light:dark cycle. Animal caging will be cleaned in accordance with the above SOPs, and all animals will be observed twice daily by RSC personnel for any signs of pain, distress, or any other abnormalities. While housed in Building 838, animals will have access to food and water *ad libitum* except for during cage acclimation.

V.5.1.1. Study Room

All inhalation exposures will be conducted in room 265 of building 837. Behavioral observations will take place in room 259 or 269 of Building 837. Food will not be provided during exposure, while water will be provided *ad libitum*. Neither food nor water will be provided during behavioral observations.

V.5.1.2. Special Husbandry Provisions

Wire-bottom cages are used in whole-body inhalation chambers to ensure that the exposure atmosphere in the chamber is uniformly distributed to all cage units so that all rats will be exposed to the same concentration of test material. Additionally, rats will need to be housed separately while in the vivarium so that food consumption for individual rats can be measured.

V.5.1.3. Exceptions

Following facility and cage acclimation, rats will be individually housed during exposure and non-exposure times. Individual housing during exposure is necessary so as to ensure proper distribution of the fuel within the chambers. Individual housing during non-exposure time is necessary in order to measure the daily food consumption for each rat.

V.5.2. Veterinary Medical Care

V.5.2.1. Routine Veterinary Medical Care

Animals will be observed twice daily for signs of distress and the observations will be recorded by RSC staff. The PI will be contacted if an animal is discovered in a moribund condition or appears to be in intense pain during duty hours (0730-1600, Monday-Friday). At that time, the PI will consult with the Attending Veterinarian as to appropriate actions to be taken for the well-being of the animal. If any unexpected animal deaths occur, the PI will immediately notify the Attending Veterinarian (or alternate) for consultation as to the cause of death, any immediate corrective actions to institute, and the need for a necropsy.

V.5.2.2. Emergency Veterinary Medical Care

During normal duty hours, animal health care emergencies should be reported to the RSC Facility Manager (937-255-7210) or Attending Veterinarian (937-255-8510). After normal duty hours, weekends, and holidays, animal health care emergencies should be reported as described in the memorandum document "Emergency Veterinary Medical Care" describing procedures for contacting emergency personnel. This document is posted on the bulletin board across from the Attending Veterinarian's office (Room 59). During off-duty hours, the PI will authorize the RSC staff, at the discretion of the Attending Veterinarian, to euthanize any animal that is found moribund, or appears to be in intense, unrelievable pain. The carcass of the animal will be placed in a plastic bag along with its cage card. The bag will then be placed in the walk-in refrigerator in Necropsy, Room 67, Bldg 838. The RSC staff will then alert the PI by email as to the condition of the animal and the animal number on the cage card.

V.5.3. Environmental Enrichment

V.5.3.1. Enrichment Strategy

Animals will be pair housed for enrichment purposes during the facility and cage acclimation periods (when outside of wire mesh cages). Animals will be individually housed in the exposure chambers to enable the free flow of test atmosphere around the animal. Animals that are group housed may huddle or gather together, acting as a filter to remove test material from the atmosphere or otherwise disrupt fuel distribution within the chamber. In the domiciliary cages during non-exposure periods, they will be individually housed to monitor food consumption. Enrichment items (e.g., nylabones) may be used in domiciliary cages.

Enrichment will be provided by the WPAFB RSC staff in accordance with RSC SOP 603.

V.5.3.2. Enrichment Restrictions

Enrichment items (e.g., nylabones) may not be permitted in exposure chambers as they could interfere with the free flow of the exposure atmosphere. Additionally, Gevo fuel droplets could deposit on the enrichment items and be ingested as the animal chews on it. It is desirable to limit the ingestion of the test substance as much as possible.

VI. STUDY PERSONNEL QUALIFICATIONS AND TRAINING

General Activities:

Activity	Name of Person	Qualifications	Training
Principal Investigator, animal handling, blood draw, vaginal lavage, tissue harvest	Karen Mumy	Ph.D., Microbiology, 9 years animal handling experience including clinical observations, euthanasia, necropsy, and tissue harvest.	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling, blood draw, vaginal lavage, IP injections, anesthesia (via IP), IP injections, euthanasia, tissue harvest	Nathan Gargas	B.S., Biological Sciences, >9 years animal handling experience including clinical observations, anesthesia (including IP injection), injections (IP), euthanasia, decapitation, necropsy and tissue harvest.	Certified AALAS Laboratory Animal Technician – 2008. WPAFB Animal User Training.
Animal handling, blood draw, anesthesia (IP), euthanasia, tissue harvest	Chet Gut	M.S., Pharmacology & Toxicology, >3 years live animal handling experience, including clinical observations, neurobehavioral testing, anesthesia, IP injections, euthanasia, necropsy, and tissue harvest.	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling, blood draw, vaginal lavage, anesthesia (via IP), euthanasia, tissue harvest	Susan Prues	B.A., Biology, Combined total of 23 years doing biomedical research; many projects involve the handling and husbandry required for research animals. Highly experienced in Toxicology studies and is proficient in all forms of dosing blood draws, injections and vaginal lavage, anesthesia, euthanasia, and necropsies and tissue harvest.	Purina Laboratory Animal Care Course Certification. WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling, vaginal lavage, blood draw, euthanasia, tissue harvest	Michelle Okolica	B.S., Biological Sciences, > 13 years live animal handling of mammals, birds, and reptiles. Five years combined professional experience, including vaginal lavage,	WPAFB Animal User Training. Completed AALAS Tier I & II training.

		intratracheal instillation euthanasia necropsy, and tissue harvest experience with birds and mammals.	
Animal handling (loading and unloading), tissue harvest	Elizabeth Phillips	B.S., Biology, ~2 years animal handling and necropsy experience.	WPAFB Animal User Training. Completed AALAS Tier I training.
Animal handling (loading and unloading), tissue harvest	David Lemmer	~2 years of animal handling experience, some euthanasia (guillotine, CO ₂)	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling (loading and unloading), tissue harvest	George Lemmer	BS. limited animal handling experience and will only work under the supervision of the more experienced study personnel	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling (loading and unloading), euthanasia, tissue harvest	Angela Hulan	Associate of Science. ~3 years small animal handling experience.	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling (loading and unloading), neurobehavioral testing, sperm analysis, tissue harvest	Molly Miklasevich, BS	B.S., Psychology, ~2 years live animal handling, neurobehavioral tests, sperm collection	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling (loading and unloading), blood draw, euthanasia, tissue harvest	Kathy Frondorf, MS	M.S. Zoology, >5 years animal handling experience including clinical observations, anesthesia, euthanasia, necropsy, tissue harvest.	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling (loading and unloading), tissue harvest	Antonio Brown	2 years small animal handling experience (rodents), experience in animal husbandry, clinical observations, sperm analysis, euthanasia (guillotine, CO ₂), necropsy, tissue harvest	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling, anesthesia, blood draw, euthanasia, tissue harvest	Tim Bausman	B.S., Mr. Bausman has a B.S. in Education and 32 years of laboratory animal research Experience in Reproductive Toxicology studies and is proficient in all forms of dosing, blood draws, injections and methods for anesthesia, euthanasia, and necropsies.	Certified AALAS Lab Animal Technologist Certified X-Ray Technologist WPAFB animal handlers training Purina Laboratory Animal Care Course Certification RCRA training (biohazards and chemical)
Animal handling, anesthesia, blood draw,	Dick Godfrey	Mr. Godfrey has 38 years of laboratory animal	Certified AALAS Animal Technologist – 1980

euthanasia, tissue harvest		research experience and is certified as a Lab Animal Technologist through AALAS. Mr. Godfrey is highly experienced in Toxicology studies and is proficient in all forms of dosing, blood draws, injections and methods for anesthesia, euthanasia, and necropsies.	Laboratory Animal Medicine and Science Series - 1980 Purina Animal Care WPAFB Animal User Training, RCRA training (biohazards and chemical)
Animal handling (loading and unloading), tissue harvest	Erika Amburgey	A.S., Biotechnology, Certificate in Histology. <1 year animal handling experience and will only work under the supervision of the more experienced study personnel.	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal Handling (loading and unloading)	TSgt MaryElizabeth Penny	Limited animal handling experience and will work under the supervision of experience study personnel	AALAS Tier 1 Training
Animal Handling (loading and unloading)	SSgt Kandice Salinas	Limited animal handling experience and will work under the supervision of experience study personnel	AALAS Tier 1 Training

Specialized Activities:

Activity	Name of Person	Qualifications	Training
Co-Investigator, study design	David R. Mattie	Diplomat of the American Board of Toxicology. He is currently a Senior Research Toxicologist. Over 30 years of experience in toxicology research, including blood draws, anesthesia, euthanasia, necropsy and tissue harvest.	Investigator course refresher training (20 Oct 05) GLP training (attended again in July 05 and Feb 09), RCRA training WPAFB Animal User Training.
Co-Investigator, Data analysis	Brian Wong	Ph.D., Environmental Engineering Science, limited animal handling experience and will work under the supervision of the more experienced study personnel.	WPAFB Animal User Training. Completed AALAS Tier I & II training.
Animal handling, neurobehavioral testing,	Shawn McInturf	M.S., Applied Behavioral Science, >15 years	WPAFB Animal User Training. RCRA training

blood draw, anesthesia (via IP), euthanasia, tissue harvest		practical animal handling experience. Trained in anesthesia (IP and CO ₂), euthanasia (to include guillotine), pup handling and manipulation, and rodent necropsy. Expert in conducting animal neurobehavioral testing (NHRC NTAB WPAFB protocol).	(biohazards and chemical). Completed AALAS Tier I & II training.
Neurobehavioral testing	Vivian Vralsted	>8 years live animal handling experience, including neurobehavioral testing, euthanasia, and tissue harvesting. Experience in, euthanasia (CO ₂ , cervical dislocation, decapitation), anesthesia.	WPAFB Animal User Training. Completed AALAS Tier I & II training.

All personnel involved in the protocol have attended the WPAFB Investigator Training Course, or are scheduled to take the next available one offered.

The high number of people listed on this protocol is due to the length and involvement of the 90-day inhalation study. Many people perform very specialized portions of this protocol, while others are involved in the daily activities of load and unloading the animals. Given the daily tasks, a number of people need to be included in order to ensure coverage of tasks over the 3-month duration should people become ill, take leave, or have conflicting schedules. All those listed are expected to participate in the study. To ease tracking of personnel, NAMRU-D will provide the vivarium staff with a schedule in advance of who will be performing tasks for the upcoming weeks.

Training logs will be kept and updated over the course of the study; all personnel will be expected to document review of the animal protocol and required SOPs.

VII. BIOHAZARDS/SAFETY:

Personal protective equipment such as gloves, goggles or safety glasses, and lab coats will be worn when handling Gevo fuel and rats.

VIII. ENCLOSURES

V.III.1 Enclosure 1: Gevo Fuel Information

V.III.1.1 Gevo HSAF

V.III.1.2 Gevo MSDS

V.III.2 Enclosure 2: Cyclophosphamide Information

- V.III.2.1 Cyclophosphamide HSAF
- V.III.2.2 Cyclophosphamide MSDS
- V.III.3 Enclosure 3: NAMRU-D SOP 530-22: Vaginal Lavage Sampling
- V.III.4 Enclosure 4: NAMRU-D SOP 510-01: Functional Observational Battery Test
- V.III.5 Enclosure 5: NAMRU-D SOP 510-04: Motor Activity Test

IX. ASSURANCES

PROTOCOL TITLE: 90-Day Inhalation Toxicity Study of Gevo Jet Blend Stock Fuel in Rats (*Rattus norvegicus*) with Neurotoxicity Testing and Genotoxicity Assay

As the Principal Investigator on this protocol, I acknowledge my responsibilities and provide assurances for the following:

A. Animal Use: The animals authorized for use in this protocol will be used only in the activities and in the manner described herein, unless a modification is specifically approved by the IACUC prior to its implementation.

B. Duplication of Effort: I have made every effort to ensure that this protocol is not an unnecessary duplication of previous experiments.

C. Statistical Assurance: I assure that I have consulted with a qualified individual who evaluated the experimental design with respect to the statistical analysis, and that the minimum number of animals needed for scientific validity will be used.

D. Biohazard / Safety: I have taken into consideration and made the proper coordinations regarding all applicable rules and regulations concerning radiation protection, biosafety, laboratory safety, recombinant issues, etc., in the preparation of this protocol.

E. Training: I verify that the personnel performing the animal procedures / manipulations / observations described in this protocol are technically competent and have been properly trained to ensure that no unnecessary pain or distress will be caused to the animals as a result of the procedures / manipulations.


F. Responsibility: I acknowledge the inherent moral, ethical, and administrative obligations associated with the performance of this animal use protocol, and I assure that all individuals associated with this project will demonstrate a concern for the health, comfort, welfare, and well-being of the research animals. Additionally, I pledge to conduct this study in the spirit of the fourth "R", namely, "Responsibility," which the DoD has embraced for implementing animal use alternatives where feasible and conducting humane and lawful research.

G. Scientific Review: This proposed animal use protocol has received appropriate peer scientific review and is consistent with good scientific research practice.

H. Painful Procedure(s): A signature for this assurance is required by the Principal Investigator if the research being conducted has the potential to cause more than momentary or slight pain or distress even if an anesthetic or analgesic is used to relieve the pain and/or distress.

I am conducting biomedical experiments, which may potentially cause more than momentary or slight pain or distress to animals. This potential pain and/or distress ~~WILL~~/WILL NOT be relieved with the use of anesthetics, analgesics, and/or tranquilizers. I have considered alternatives to such procedures; however, I have determined that alternative procedures are not available to accomplish the objectives of this proposed experiment.

Karen L. Mumy
(Printed Name)


(Signature)

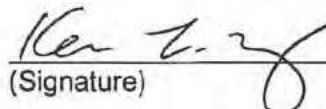
19 April 2013
(Date)

I. Occupational Health Program: I acknowledge the inherent risks associated with animal contact, such as allergies and zoonoses. I have made a reasonable, good faith effort to ensure all persons with animal contact, working on this protocol are enrolled in an Occupational Health Program.

Name	Enrollment Date	Provider
AMBURGEY, ERIKA	8-Feb-13	CONCENTRA (Dayton, OH)
BROWN, ANTONIO	21-Jun-12	CONCENTRA (Dayton, OH)
FRONDORF, KATHY	26-Apr-12	CONCENTRA (Dayton, OH)
GARGAS, NATHAN	20-Aug-12	Medworks (Dayton, OH)
GUT, CHET	18-Sep-12	CONCENTRA (Dayton, OH)
HULGAN, ANGELA	22-Jun-12	CONCENTRA (Dayton, OH)
LEMMER, DAVID	21-Jun-12	CONCENTRA (Dayton, OH)
LEMMER, GEORGE	29-Jun-12	CONCENTRA (Dayton, OH)
MATTIE, DAVID	13-May-11	Base Occ Health Bldg 675
MCINTURF, SHAWN	1-Mar-13	CONCENTRA (Dayton, OH)
MIKLASEVICH, MOLLY	23-Jul-12	CONCENTRA (Dayton, OH)
MUMY, KAREN	7-Feb-12	Base Occ Health Bldg 675
OKOLICA, MICHELLE	18-Dec-12	CONCENTRA (Dayton, OH)
PHILLIPS, ELIZABETH	Oct-12	CONCENTRA (Dayton, OH)
PRUES, SUSAN	11-Dec-11	Base Occ Health Bldg 675
VRLSTED, VIVIAN	19-Mar-13	CONCENTRA (Dayton, OH)
WONG, BRIAN	11-Sep-12	Medworks (Dayton, OH)
GODFREY, DICK	22-May-12	Medworks (Dayton, OH)
BAUSMAN, TIM	14-May-12	Medworks (Dayton, OH)
TSgt PENNY, MARYELIZABETH	20-Dec-12	Base Occ Health Bldg 675
SSgt SALINAS, KANDICE	01/2010 Scheduled April 2013	Base Occ Health Bldg 675

Civilian and military members listed that are outside of the 1-year timeframe on the occupational health visits are currently working with Base Occupational Health for updated consults and appointments as necessary. Anyone outside of the 1-year timeframe will not handle the animals until cleared by Occupational Health.

Karen L. Mumy
(Printed Name)


(Signature)

19 April 2013
(Date)

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APPENDIX B. INHALATION EXPOSURE SUMMARY

CHAMBER DISTRIBUTION

200 mg/m³ Gevo (bio) ATJ SPK Exposure Chamber Uniformity Measurements

Position	Average Concentration (mg/m ³)	Position	Average Concentration (mg/m ³)
Center	195		
		Animal Side Top Left	194
		FTIR Side Top Left	193
		Animal Side Top Right	194
Center	195		
		FTIR Side Top Right	195
		FTIR Side Bottom Left	194
		Animal Side Bottom Left	193
Center	195		
		FTIR Side Bottom Right	194
		Animal Side Bottom Right	195
Center	195		
		Center (average)	195
Mean	195	Average	194
SD	0	SD	1
Temporal CV	0.0	Total variation CV	0.4
Spatial CV	0.4		

Note: $(CV_{\text{Spatial}})^2 = (CV_{\text{Total}})^2 - (CV_{\text{Temporal}})^2$ where CV = coefficient of variation. Reference: Cheng and Moss. 1985. Inhalation Exposure Systems. In: Concepts in Inhalation Toxicology, 2nd ed., R. O McClellan and R. F. Henderson, eds., Taylor and Francis, Washington, D.C.

700 mg/m³ Gevo (bio) ATJ SPK Exposure Chamber Uniformity Measurements

Position	Average Concentration (mg/m³)	Position	Average Concentration (mg/m³)
Center	687		
		Animal Side Top Left	686
		FTIR Side Top Left	687
		Animal Side Top Right	689
Center	691		
		FTIR Side Top Right	691
		FTIR Side Bottom Left	684
		Animal Side Bottom Left	682
Center	693		
		FTIR Side Bottom Right	687
		Animal Side Bottom Right	684
Center	693		
		Center (average)	691
Mean	691	Average	687
SD	3	SD	3
Temporal CV	0.41	Total variation CV	0.46
Spatial CV	0.21		

Note: $(CV_{\text{Spatial}})^2 = (CV_{\text{Total}})^2 - (CV_{\text{Temporal}})^2$ where CV = coefficient of variation. Reference: Cheng and Moss (1985).

2000 mg/m³ Gevo (bio) ATJ SPK Exposure Chamber Uniformity Measurements

Position	Average Concentration (mg/m³)	Position	Average Concentration (mg/m³)
Center	1970		
		Animal Side Top Left	1967
		FTIR Side Top Left	1979
		Animal Side Top Right	1968
Center	1970		
		FTIR Side Top Right	1980
		FTIR Side Bottom Left	1977
		Animal Side Bottom Left	1957
Center	1966		
		FTIR Side Bottom Right	1963
		Animal Side Bottom Right	1978
Center	1994		
		Center (average)	1975
Mean	1975	Average	1972
SD	12.81	SD	8.13
Temporal CV	0.65	Total variation CV	0.41
Spatial CV	<0.0		

Note: $(CV_{\text{Spatial}})^2 = (CV_{\text{Total}})^2 - (CV_{\text{Temporal}})^2$ where CV = coefficient of variation. Reference: Cheng and Moss (1985).

IN-STUDY CONDITIONS

Gevo (bio) ATJ SPK Aerosol Concentration - Gravimetric Measurements

Week	Aerosol Concentration			
	2000 mg/m ³ Chamber (mg/m ³)	700 mg/m ³ Chamber (mg/m ³)	200 mg/m ³ Chamber (mg/m ³)	Control Chamber (mg/m ³)
	47.16	4.84	0.00	0.00
2	49.09	4.64	0.21	0.20
3	47.01	3.46	2.91	4.14
4	51.49	3.40	0.33	0.20
5	30.33	2.51	0.85	0.10
6	51.05	3.77	2.29	0.45
7	46.65	3.50	1.89	2.10
8	49.42	4.87	2.61	1.72
9	43.43	2.85	2.87	3.76
10	53.98	3.49	1.98	0.91
11	48.34	2.97	5.08	1.39
12	42.64	3.62	0.74	2.46
13	47.49	3.64	1.17	0.14
14	47.51	3.27	2.57	0.49
15	42.92	2.34	0.59	0.20
Mean	46.57	3.54	1.74	1.22
SD	5.49	0.76	1.37	1.36

Note: SD = standard deviation

Gevo (bio) ATJ SPK Particle Size Distribution Results from Aerodynamic Particle Sizer

Week	2000 mg/m ³ Chamber		700 mg/m ³ Chamber		200 mg/m ³ Chamber		Control Chamber	
	MMAD	GSD	MMAD	GSD	MMAD	GSD	MMAD	GSD
1	3.38	1.80	1.96	2.01	1.20	1.64	6.68	1.98
2	3.34	1.81	1.86	1.85	1.28	1.68	5.50	1.81
3	3.45	1.79	1.91	1.84	1.21	1.75	7.40	1.71
4	3.44	1.80	1.75	1.80	1.24	1.64	5.50	2.00
5	3.47	1.87	1.88	1.94	1.30	1.83	4.76	2.09
6	3.38	1.91	1.93	1.84	1.32	1.86	1.59	1.83
7	3.54	1.83	1.85	1.87	1.22	1.82	4.26	1.83
8	3.51	1.85	1.97	1.95	1.26	1.64	2.03	1.90
9	3.32	1.93	1.78	1.82	1.21	1.64	4.73	1.77
10	3.44	1.87	1.92	1.90	1.31	1.79	3.11	1.93
11	3.21	1.93	1.70	1.83	1.21	1.61	2.76	1.76
12	3.32	1.89	1.75	1.82	1.18	1.79	2.34	1.72
13	3.19	1.95	1.92	1.85	1.19	1.79	1.27	1.60
14	3.23	1.93	1.77	1.91	1.19	1.70	0.85	1.52
15	3.40	1.86	1.88	1.83	1.27	1.86	1.67	1.71
Mean	3.38	1.87	1.86	1.87	1.24	1.74	3.63	1.81
SD	0.11	0.05	0.09	0.06	0.05	0.09	2.07	0.15

Note: Table units in μm ; GSD = geometric standard deviation; MMAD = mass median aerodynamic diameter, SD = standard deviation

Gevo (bio) ATJ SPK Particle Size Distribution Results from Impactor

Week	2000 mg/m ³ Chamber		700 mg/m ³ Chamber		200 mg/m ³ Chamber		Control Chamber	
	MMAD	GSD	MMAD	GSD	MMAD	GSD	MMAD	GSD
1	2.27	2.33	2.73	2.28	2.08	2.89	1.77	3.01
2	2.57	2.22	2.78	2.14	1.89	2.17	2.72	3.19
3	2.39	2.31	2.33	2.65	3.19	3.07	0.57	3.12
4	2.33	2.35	2.03	2.79	2.08	3.44	2.81	2.14
5	2.25	2.10	2.63	2.82	2.71	2.61	3.24	2.21
6	2.50	2.23	2.29	2.86	3.27	2.20	3.23	2.73
7	2.04	2.18	1.94	3.45	3.68	2.46	1.63	5.05
8	2.53	2.08	1.23	3.97	2.18	3.84	2.40	3.24
9	2.22	2.18	2.14	2.48	2.17	3.17	1.97	4.01
10	2.23	2.20	2.34	2.73	2.07	3.55	2.70	2.77
11	2.38	2.17	2.61	3.03	2.54	2.98	1.43	5.18
12	2.35	2.23	2.39	2.89	2.43	2.98	2.30	4.94
13	2.19	2.46	2.72	2.77	2.73	3.28	2.48	3.06
14	2.34	2.21	1.94	3.54	2.38	3.05	2.83	2.84
Mean	2.33	2.23	2.29	2.89	2.53	2.98	2.29	3.39
SD	0.14	0.10	0.42	0.49	0.53	0.49	0.75	1.01

Note: Table units in μm ; GSD = geometric standard deviation; MMAD = mass median aerodynamic diameter, SD = standard deviation

Daily Measured and Nominal Gevo (bio) ATJ SPK Concentration

Study Day	Control Measured mg/m ³	200 mg/m ³			700 mg/m ³			2000 mg/m ³		
		Nominal mg/m ³	Measured mg/m ³	% of nominal	Nominal mg/m ³	Measured mg/m ³	% of nominal	nominal mg/m ³	Measured mg/m ³	% of nominal
1	-0.17	191.68	198.47	103.55	643.85	702.21	109.06	1932.80	1996.80	103.31
2	-0.29	194.93	198.84	102.01	648.65	704.43	108.60	1955.90	2014.62	103.00
3	-0.31	197.36	200.52	101.60	648.89	699.66	107.82	1946.31	2005.36	103.03
4	-0.27	196.60	200.05	101.75	655.84	707.87	107.93	1954.17	1993.32	102.00
5	Sat									
6	Sun									
7	-0.21	196.64	199.61	101.51	650.25	709.79	109.16	1972.14	1971.10	99.95
8	-0.16	201.02	204.23	101.60	646.52	708.18	109.54	1966.04	2005.90	102.03
9	-0.43	200.04	200.81	100.38	652.31	707.57	108.47	1958.80	2006.09	102.41
10	-0.16	199.09	199.04	99.97	654.71	698.14	106.63	1988.72	2010.10	101.08
11	-0.26	197.47	200.38	101.47	649.83	699.66	107.67	1948.61	1996.42	102.45
12	Sat									
13	Sun									
14	-0.14	196.64	200.19	101.81	651.84	709.71	108.88	1964.20	2005.98	102.13
15	0.06	196.18	199.71	101.80	654.24	704.13	107.63	1962.50	2007.64	102.30
16	-0.30	201.95	203.19	100.61	653.23	713.81	109.27	1978.82	2016.43	101.90
17	0.15	197.06	199.44	101.21	650.99	699.54	107.46	1986.14	1996.39	100.52
18	0.08	195.18	200.70	102.83	643.76	702.21	109.08	1970.12	2005.52	101.80
19	Sat									
20	Sun									
21	-0.14	195.78	200.93	102.63	647.60	701.82	108.37	1967.54	1995.68	101.43
22	-0.09	197.67	201.08	101.73	647.80	703.33	108.57	1968.95	1996.33	101.39
23	0.27	194.89	200.92	103.10	645.88	705.18	109.18	1972.26	2011.98	102.01
24	0.19	195.95	202.92	103.56	651.80	710.09	108.94	1962.28	2025.40	103.22
25	-0.18	197.29	202.86	102.82	654.21	710.76	108.64	1963.00	2027.53	103.29
26	Sat									
27	Sun									
28	-0.20	198.26	201.57	101.67	654.51	707.54	108.10	1931.59	2009.81	104.05
29	-0.10	198.19	201.88	101.86	652.91	703.68	107.78	1935.92	2007.25	103.68
30	-0.17	198.27	200.96	101.36	657.25	703.49	107.04	1941.10	2006.69	103.38
31	-0.20	199.09	199.24	100.07	662.48	704.95	106.41	1955.60	2004.05	102.48
32	-0.14	196.82	199.72	101.47	657.47	699.09	106.33	1958.38	1980.89	101.15
33	Sat									
34	Sun									
35	-0.19	197.15	199.24	101.06	652.68	698.71	107.05	1946.25	1976.88	101.57
36	-0.16	196.68	199.48	101.42	652.74	699.90	107.22	1952.49	1981.77	101.50
37	-0.01	194.59	197.84	101.67	652.82	703.66	107.79	1947.49	1972.99	101.31

38	Holiday									
39	-0.09	199.18	201.98	101.40	657.15	705.80	107.40	1963.56	1991.37	101.42
40	Sat									
41	Sun									
42	-0.22	199.51	202.03	101.26	661.78	710.04	107.29	1966.72	1994.55	101.42
43	-0.34	200.09	200.75	100.33	662.30	708.32	106.95	1960.94	2002.32	102.11
44	-0.45	197.73	196.37	99.31	664.95	704.94	106.01	1972.03	1987.57	100.79
45	-0.44	200.65	198.55	98.95	659.78	706.55	107.09	1973.60	1972.76	99.96
46	-0.19	200.05	197.72	98.83	660.13	709.02	107.41	1638.72	1786.33	109.01
47	Sat									
48	Sun									
49	-0.24	200.11	188.49	94.20	655.41	707.11	107.89	1948.14	1991.27	102.21
50	-0.15	200.20	198.25	99.03	656.98	710.18	108.10	1965.70	1992.65	101.37
51	-0.22	198.84	197.63	99.39	661.94	704.45	106.42	1998.72	1997.57	99.94
52	-0.13	201.02	200.99	99.99	680.45	698.48	102.65	2024.88	2002.27	98.88
53	-0.26	198.49	199.63	100.57	665.38	682.77	102.61	1966.75	1967.83	100.06
54	Sat									
55	Sun									
56	0.05	199.19	199.28	100.05	655.14	705.99	107.76	1976.50	2017.52	102.08
57	-0.07	204.53	197.44	96.53	658.34	703.50	106.86	1968.26	2006.65	101.95
58	-0.06	196.11	198.28	101.11	649.91	700.93	107.85	1966.26	2010.93	102.27
59	0.18	196.30	200.25	102.01	649.46	702.72	108.20	1933.45	2011.30	104.03
60	0.29	195.29	201.59	103.23	647.13	702.23	108.52	1944.30	1999.47	102.84
61	Sat									
62	Sun									
63	0.01	198.27	199.64	100.69	553.89	607.26	109.64	1950.95	2004.68	102.75
64	-0.03	196.97	201.14	102.12	663.80	711.09	107.12	1970.04	2021.11	102.59
65	-0.02	197.63	201.59	102.00	653.43	705.97	108.04	1974.54	2004.66	101.53
66	-0.21	198.46	201.35	101.46	651.68	700.72	107.52	1986.14	2020.88	101.75
67	-0.22	198.34	201.41	101.55	626.00	697.32	111.39	1987.56	2019.82	101.62
68	Sat									
69	Sun									
70	-0.02	197.97	205.62	103.86	763.67	711.37	93.15	1968.31	2018.91	102.57
71	-0.22	197.42	201.12	101.88	655.93	703.83	107.30	1962.11	2014.93	102.69
72	-0.13	197.10	201.26	102.11	654.73	701.63	107.16	1976.86	2026.41	102.51
73	-0.21	198.13	201.58	101.74	654.01	704.02	107.65	1966.58	2019.99	102.72
74	-0.24	197.80	201.55	101.90	659.34	709.78	107.65	1953.53	2010.32	102.91
75	Sat									
76	Sun									
77	-0.28	197.75	202.54	102.42	657.07	714.16	108.69	1951.70	2005.26	102.74
78	-0.12	198.37	200.84	101.24	660.03	715.34	108.38	1963.38	1999.75	101.85

79	-0.17	196.33	201.82	102.80	652.62	713.37	109 31	1937.43	2001.85	103.32
80	-0.16	196.62	202.53	103.01	655.19	709.32	108 26	1950.43	2012.45	103.18
81	-0.11	198.35	204.18	102.94	661.07	719.51	108.84	1954.69	2022.39	103.46
82	Sat									
83	Sun									
84	-0.15	198.51	202.74	102.13	663.11	716.23	108.01	1950.72	2014.18	103.25
85	-0.21	199.13	202.81	101.85	660.39	716.88	108 55	1960.64	2015.97	102.82
86	-0.20	197.96	200.05	101.06	661.12	715.80	108 27	1960.33	2017.39	102.91
87	0.04	197.59	202.32	102.39	664.68	722.13	108.64	1958.84	2025.63	103.41
88	-0.05	197.28	202.62	102.71	661.79	719.46	108.72	1968.61	2010.23	102.11
89	Sat									
90	Sun									
91	-0.29	199.01	202.18	101.60	662.09	717.76	108.41	1962.60	2019.65	102.91
92	-0.19	202.51	198.67	98.11	661.83	711.00	107.43	1972.95	1999.43	101.34
93	-0.16	198.11	199.80	100.85	662.74	709.63	107.07	1976.15	2007.51	101.59
94	-0.11	198.11	201.32	101.62	655.89	718.54	109 55	1966.38	2002.71	101.85
95	-0.11	199.01	201.93	101.47	646.61	706.13	109 20	1969.40	2012.74	102.20
96	Sat									
97	Sun									
98	Holiday									
99	0.15	198.95	200.58	100.82	656.02	711.03	108 39	1976.22	2013.58	101.89
100	0.10	199.32	202.66	101.67	655.55	718.34	109 58	1965.46	2020.55	102.80
Mean	-0.13	198.01	200.56	101.30	655.36	705.57	107.71	1958.56	2001.77	102.23
SD	0.15	1.96	2 28	1.56	19.23	13.65	2.20	41.79	29.54	1.31

Note: Sat = Saturday; SD = standard deviation; Sun = Sunday

Gevo (bio) ATJ SPK Fuel Consumption for Determination of Nominal (mg/m³) Concentration

Study Day	200 mg/m ³			700 mg/m ³			2000 mg/m ³		
	Start(g)	End(g)	Nominal	Start(g)	End(g)	Nominal	Start(g)	End(g)	Nominal
1	1059.7	1044.2	191.7	1094.8	1042.6	643.8	1020.5	864.2	1932.8
2	1044.1	1028.3	194.9	1042.5	989.7	648.6	864.1	705.6	1955.9
3	1028.2	1012.2	197.4	989.6	936.5	648.9	705.5	547.1	1946.3
4	1010.7	994.8	196.6	936.5	883.4	655.8	1165.3	1006.5	1954.2
5	Sat								
6	Sun								
7	996.6	980.6	196.6	881.8	828.9	650.3	1006.3	845.7	1972.1
8	979.3	963.1	201.0	827.4	775.1	646.5	845.4	685.9	1966.0
9	963.1	946.9	200.0	774.9	722.3	652.3	685.8	527.7	1958.8
10	946.8	930.7	199.1	722.2	669.0	654.7	1189.8	1029.0	1988.7
11	927.0	910.9	197.5	669.0	615.8	649.8	1028.9	869.9	1948.6
12	Sat								
13	Sun								
14	910.7	894.8	196.6	615.2	562.2	651.8	869.4	710.5	1964.2
15	894.7	878.8	196.2	562.0	508.7	654.2	710.5	551.5	1962.5
16	879.1	862.7	201.9	1116.0	1062.8	653.2	1119.0	958.6	1978.8
17	862.6	846.6	197.1	1062.7	1009.7	651.0	958.5	797.2	1986.1
18	846.5	830.5	195.2	1009.4	956.5	643.8	796.7	635.2	1970.1
19	Sat								
20	Sun								
21	830.2	814.2	195.8	956.1	903.1	647.6	635.0	474.3	1967.5
22	814.2	798.1	197.7	902.9	850.0	647.8	1165.9	1005.6	1969.0
23	798.0	782.0	194.9	849.9	796.7	645.9	1005.6	843.7	1972.3
24	782.0	766.1	195.9	796.5	743.6	651.8	843.5	684.8	1962.3
25	766.1	750.1	197.3	743.6	690.6	654.2	684.6	526.1	1963.0
26	Sat								
27	Sun								
28	750.0	733.9	198.3	690.3	637.2	654.5	1159.4	1002.9	1931.6
29	734.0	717.8	198.2	637.1	584.1	652.9	1002.7	844.9	1935.9
30	717.9	701.7	198.3	584.0	530.7	657.2	844.8	686.8	1941.1
31	701.8	685.6	199.1	530.7	477.2	662.5	686.8	528.2	1955.6
32	685.6	669.6	196.8	1144.1	1090.8	657.5	1212.6	1053.8	1958.4
33	Sat								
34	Sun								
35	669.3	653.1	197.1	1090.4	1036.8	652.7	1053.3	893.3	1946.3
36	653.2	637.0	196.7	1036.6	982.9	652.7	893.2	732.4	1952.5
37	637.0	620.9	194.6	982.8	928.9	652.8	732.3	571.6	1947.5

38	Holiday								
39	620.7	604.5	199.2	928.7	875.3	657.2	1110.1	950.6	1963.6
40	Sat								
41	Sun								
42	603.8	587.6	199.5	875.1	821.5	661.8	950.2	790.9	1966.7
43	587.8	571.6	200.1	821.5	768.0	662.3	790.9	632.5	1960.9
44	747.6	731.6	197.7	768.1	714.3	664.9	913.2	753.8	1972.0
45	731.7	715.5	200.6	714.2	660.8	659.8	753.8	594.1	1973.6
46	715.6	699.4	200.0	660.8	607.2	660.1	594.0	461.0	1638.7
47	Sat								
48	Sun								
49	699.4	683.1	200.1	607.1	553.7	655.4	1093.0	934.5	1948.1
50	683.2	666.9	200.2	1068.7	1015.2	657.0	934.4	774.5	1965.7
51	667.0	650.8	198.8	1015.1	961.2	661.9	774.5	611.9	1998.7
52	650.8	634.5	201.0	961.3	906.2	680.5	1136.0	972.2	2024.9
53	634.5	618.4	198.5	906.2	852.3	665.4	972.2	813.1	1966.7
54	Sat								
55	Sun								
56	618.4	602.3	199.2	852.0	798.9	655.1	812.9	652.9	1976.5
57	602.4	585.7	204.5	798.8	745.3	658.3	652.8	493.1	1968.3
58	1104.1	1088.0	196.1	745.3	692.0	649.9	1135.6	974.7	1966.3
59	1088.0	1071.8	196.3	691.9	638.4	649.5	974.6	815.6	1933.5
60	1071.8	1055.7	195.3	638.3	585.1	647.1	815.4	655.8	1944.3
61	Sat								
62	Sun								
63	1055.8	1039.4	198.3	585.0	539.3	553.9	655.6	494.9	1950.9
64	1039.5	1023.2	197.0	1141.4	1086.6	663.8	1198.3	1035.9	1970.0
65	1023.4	1007.1	197.6	1086.4	1032.6	653.4	1036.0	873.7	1974.5
66	1007.2	990.9	198.5	1032.4	979.0	651.7	873.7	711.2	1986.1
67	991.0	974.7	198.3	979.0	927.7	626.0	711.1	548.5	1987.6
68	Sat								
69	Sun								
70	974.5	958.5	198.0	927.1	865.0	763.7	1119.0	959.1	1968.3
71	958.6	942.5	197.4	865.1	811.9	655.9	959.0	800.3	1962.1
72	942.6	926.5	197.1	811.6	758.6	654.7	800.3	639.5	1976.9
73	926.6	910.5	198.1	758.4	705.4	654.0	1202.9	1042.5	1966.6
74	910.5	894.4	197.8	705.3	651.7	659.3	1042.4	882.6	1953.5
75	Sat								
76	Sun								
77	894.4	878.3	197.7	651.5	598.1	657.1	882.2	722.7	1951.7
78	878.3	862.2	198.4	1151.5	1098.0	660.0	722.6	562.3	1963.4

79	862.2	846.1	196.3	1097.9	1044.4	652.6	1163.6	1003.7	1937.4
80	846.1	830.0	196.6	1044.2	990.6	655.2	1003.5	842.9	1950.4
81	830.1	814.0	198.4	990.4	936.6	661.1	842.8	683.2	1954.7
82	Sat								
83	Sun								
84	814.0	797.9	198.5	936.3	882.4	663.1	682.8	524.6	1950.7
85	798.0	781.8	199.1	882.3	828.5	660.4	1162.9	1003.6	1960.6
86	781.8	765.7	198.0	828.4	774.6	661.1	1003.4	844.4	1960.3
87	765.8	749.7	197.6	774.5	720.4	664.7	844.2	685.2	1958.8
88	749.7	733.6	197.3	720.4	666.4	661.8	685.1	525.0	1968.6
89	Sat								
90	Sun								
91	733.6	717.4	199.0	666.2	612.3	662.1	1110.8	951.5	1962.6
92	717.5	701.0	202.5	612.2	558.3	661.8	951.4	791.4	1972.9
93	701.1	685.0	198.1	558.4	504.4	662.7	791.3	630.5	1976.1
94	685.1	669.0	198.1	1116.3	1062.9	655.9	1184.2	1024.7	1966.4
95	669.1	653.0	199.0	1062.8	1010.3	646.6	1024.6	865.4	1969.4
96	Sat								
97	Sun								
98	Holiday								
99	652.9	636.7	199.0	1009.4	955.8	656.0	865.0	704.1	1976.2
100	636.8	620.6	199.3	955.6	902.1	655.5	704.0	544.2	1965.5

Note: Nominal = mass of fuel used / (airflow * exposure time); (start (g) – end (g))/81.0 m³; Sat = Saturday; SD = standard deviation; Sun = Sunday

Chamber Temperature, Relative Humidity, and Static Pressure

Study Day	Control Chamber			200 mg/m ³ Chamber			700 mg/m ³ Chamber			2000 mg/m ³ Chamber		
	Temp C	RH %	SP "H ₂ O	Temp C	RH %	SP "H ₂ O	Temp C	RH %	SP "H ₂ O	Temp C	RH %	SP "H ₂ O
1	23.8	45	0.16	23.1	46	-0.07	22.8	49	-0.08	22.4	51	-0.10
2	24.2	46	0.18	23.4	47	-0.06	23.4	51	-0.10	23.2	54	-0.09
3	24.2	48	0.20	23.4	49	-0.05	23.0	60	-0.19	23.1	53	-0.14
4	24.2	48	0.18	23.4	49	-0.05	23.3	52	-0.19	23.1	55	-0.16
5	Sat											
6	Sun											
7	21.2	50	0.11	20.4	52	-0.14	20.7	54	-0.19	20.2	59	-0.10
8	21.8	42	0.15	21.1	42	-0.14	21.1	45	-0.18	20.8	49	-0.12
9	23.2	43	0.30	22.6	45	-0.14	22.6	48	-0.11	22.3	50	-0.15
10	23.7	56	0.36	23.0	58	-0.38	23.0	59	-0.33	22.7	63	-0.28
11	22.4	55	0.37	21.7	57	-0.39	21.8	60	-0.32	21.5	60	-0.28
12	Sat											
13	Sun											
14	23.7	60	0.35	23.1	61	-0.37	23.0	63	-0.31	22.9	65	-0.26
15	23.3	58	0.40	22.5	60	-0.34	22.5	62	-0.28	22.3	63	-0.22
16	21.8	63	0.25	21.1	65	-0.25	21.1	67	-0.33	20.7	69	-0.29
17	23.4	49	0.15	22.7	50	-0.38	22.6	52	-0.45	22.3	55	-0.41
18	23.3	48	0.16	22.6	49	-0.36	22.4	52	-0.44	22.2	53	-0.39
19	Sat											
20	Sun											
21	23.3	50	0.19	22.6	51	-0.33	22.4	53	-0.40	22.2	55	-0.35
22	23.4	49	0.18	22.6	50	-0.34	22.5	52	-0.43	22.1	55	-0.37
23	23.3	44	0.17	22.6	46	-0.37	22.4	49	-0.46	22.1	50	-0.40
24	23.3	45	0.38	22.5	46	-0.25	22.3	49	-0.27	22.0	51	-0.42
25	23.4	47	0.36	22.6	48	-0.23	22.4	52	-0.25	22.2	53	-0.40
26	Sat											
27	Sun											
28	23.0	50	0.19	22.3	51	-0.23	22.1	55	-0.25	21.7	54	-0.38
29	23.4	53	0.24	22.6	54	-0.17	22.4	57	-0.19	22.1	57	-0.27
30	23.5	50	0.22	22.7	51	-0.15	22.5	54	-0.20	22.2	54	-0.29
31	23.4	51	0.22	22.6	52	-0.16	22.5	55	-0.21	22.2	55	-0.29
32	23.4	52	0.25	22.6	53	-0.13	22.5	57	-0.15	22.1	59	-0.23
33	Sat											
34	Sun											
35	23.4	51	0.22	22.7	51	-0.17	22.5	54	-0.19	22.1	57	-0.30
36	23.4	49	0.24	22.6	50	-0.15	22.5	52	-0.16	22.2	56	-0.26

37	23.4	49	0 26	22.6	51	-0.14	22.5	53	-0.14	22.0	57	-0.22
38	Holiday											
39	23.4	49	0 12	22.7	50	-0.08	22.5	52	-0.15	22.2	56	-0.25
40	Sat											
41	Sun											
42	23.4	52	0 14	22.7	55	-0.07	22.5	57	-0.13	22.1	59	-0.23
43	23.4	58	0 15	22.6	58	-0.06	22.5	60	-0.11	22.0	63	-0.20
44	23.4	61	0 19	22.7	63	-0.19	22.6	64	-0.06	22.2	66	-0.13
45	23.3	50	0 13	22.6	50	-0.26	22.5	54	-0.14	22.1	55	-0.24
46	23.4	47	0 13	22.6	49	-0.25	22.5	53	-0.13	22.2	50	-0.23
47	Sat											
48	Sun											
49	23.4	54	0 16	22.7	55	-0.23	22.5	57	-0.09	22.2	58	-0.17
50	23.5	57	0 18	22.6	59	-0.20	22.5	61	-0.07	22.2	62	-0.15
51	23.3	59	0 17	22.4	62	-0.21	22.4	63	-0.08	22.1	64	-0.15
52	23.4	58	0 17	22.4	61	-0.21	22.4	62	-0.07	22.1	63	-0.14
53	23.5	61	0 19	22.5	64	-0.18	22.5	65	-0.06	22.2	68	-0.12
54	Sat											
55	Sun											
56	23.4	53	0 16	22.5	55	-0.18	22.5	56	-0.08	22.0	58	-0.16
57	23.4	56	0 12	22.5	58	-0.26	22.4	59	-0.46	22.1	61	-0.08
58	23.5	46	0 09	22.6	49	-0.30	22.6	49	-0.53	22.2	54	-0.15
59	23.5	45	0 10	22.7	47	-0.31	22.6	49	-0.53	22.2	51	-0.15
60	23.4	47	0 12	22.6	48	-0.28	22.5	52	-0.49	22.1	51	-0.11
61	Sat											
62	Sun											
63	23.4	45	0 10	22.6	47	-0.30	22.4	49	-0.52	22.1	51	-0.14
64	23.5	46	0 12	22.7	47	-0.28	22.5	51	-0.50	22.3	51	-0.12
65	23.4	47	0 09	22.7	49	-0.31	22.6	51	-0.54	22.3	53	-0.16
66	23.5	49	0 10	22.7	50	-0.30	22.6	51	-0.52	22.2	53	-0.14
67	23.5	46	0 08	22.7	47	-0.29	22.6	50	-0.49	22.2	54	-0.12
68	Sat											
69	Sun											
70	23.4	47	0 31	22.6	47	-0.23	22.5	50	-0.20	22.1	52	-0.08
71	23.4	46	0 33	22.7	47	-0.16	22.5	50	-0.19	22.2	54	-0.19
72	23.5	52	0 34	22.7	54	-0.14	22.5	56	-0.26	22.2	60	-0.27
73	23.4	54	0 32	22.6	56	-0.18	22.5	58	-0.27	22.1	61	-0.28
74	23.4	51	0 29	22.7	52	-0.20	22.5	54	-0.29	22.2	57	-0.31
75	Sat											
76	Sun											
77	23.4	50	0 34	22.7	51	-0.17	22.5	52	-0.25	22.2	57	-0.25

78	23.5	49	0 31	22.8	49	-0.19	22.6	51	-0.27	22.4	55	-0.30
79	23.3	41	0 29	22.7	43	-0.22	22.5	44	-0.32	22.1	46	-0.34
80	23.4	45	0 30	22.8	44	-0.22	22.6	48	-0.30	22.3	49	-0.33
81	23.3	46	0 34	22.7	46	-0.22	22.5	50	-0.15	22.1	50	-0.22
82	Sat											
83	Sun											
84	23.4	48	0 38	22.7	48	-0.19	22.6	52	-0.12	22.2	53	-0.21
85	23.5	48	0.41	22.8	48	-0.17	22.6	52	-0.09	22.3	52	-0.19
86	23.4	49	0.41	22.6	52	-0.18	22.5	52	-0.10	22.1	54	-0.19
87	23.2	50	0.41	22.4	53	-0.19	22.2	53	-0.09	21.8	54	-0.18
88	23.2	49	0.40	22.4	50	-0.19	22.3	51	-0.09	21.8	54	-0.18
89	Sat											
90	Sun											
91	23.5	50	0.41	22.7	53	-0.18	22.6	53	-0.10	22.2	57	-0.18
92	23.4	53	0.44	22.6	55	-0.17	22.5	56	-0.08	22.1	59	-0.14
93	23.4	54	0 28	22.6	56	-0.24	22.5	57	-0.21	22.1	61	-0.31
94	23.1	50	0 25	22.3	52	-0.37	22.2	53	-0.22	21.7	57	-0.29
95	23.2	50	0 30	22.5	52	-0.34	22.3	53	-0.17	21.9	55	-0.22
96	Sat											
97	Sun											
98	Holiday											
99	23.3	46	0 26	22.5	47	-0.41	22.4	50	-0.22	22.1	51	-0.30
100	23.2	47	0 26	22.4	48	-0.40	22.3	49	-0.22	21.8	50	-0.30
Mean	23.3	50	0 24	22.6	52	-0.22	22.5	54	-0.24	22.1	56	-0.23
SD	0.4	5	0 10	0.4	5	0.09	0.4	5	0.14	0.4	5	0.09

Note: “H₂O = inches of water; RH = relative humidity; Sat = Saturday; SD = standard deviation; SP = static pressure; Sun = Sunday; Temp - temperature

Chamber Air Flows

Study Day	Control Chamber (L/min)	200 mg/m ³ Chamber (L/min)	700 mg/m ³ Chamber (L/min)	2000 mg/m ³ Chamber (L/min)
1	225.110	214.627	215.209	214.631
2	225.453	215.157	216.111	215.102
3	225.487	215.191	217.311	216.069
4	225.045	214.652	214.901	215.729
5	Sat			
6	Sun			
7	226.967	216.025	215.981	216.207
8	224.978	213.858	214.708	215.354
9	224.867	214.953	213.991	214.202
10	226.344	214.635	215.715	214.600
11	228.826	216.473	217.410	216.657
12	Sat			
13	Sun			
14	227.274	214.610	215.855	214.717
15	227.401	215.128	216.303	215.053
16	225.524	215.582	216.225	215.162
17	225.049	215.540	216.153	215.591
18	227.433	217.712	218.259	217.707
19	Sat			
20	Sun			
21	226.604	217.017	217.337	216.877
22	225.731	216.248	216.835	216.150
23	227.635	218.053	218.800	218.024
24	227.446	215.403	215.443	214.653
25	226.637	215.276	215.037	214.289
26	Sat			
27	Sun			
28	226.658	215.570	215.359	215.059
29	226.944	217.054	215.486	216.422
30	226.527	216.965	215.267	216.103
31	225.615	216.023	214.325	215.279
32	225.207	215.811	215.191	215.243
33	Sat			
34	Sun			
35	227.931	218.258	218.119	218.359
36	228.549	218.796	218.522	218.768
37	229.353	219.831	219.348	219.212

38	Holiday			
39	225.919	215.922	215.722	215.639
40	Sat			
41	Sun			
42	225.188	215.554	214.982	214.994
43	224.745	214.898	214.387	214.383
44	225.285	214.776	214.747	214.529
45	224.967	214.271	214.824	214.772
46	225.822	214.948	215.546	215.447
47	Sat			
48	Sun			
49	226.235	216.270	216.323	215.999
50	226.139	216.164	216.205	215.959
51	226.112	216.314	216.187	215.978
52	224.910	215.237	214.933	214.705
53	224.957	215.309	215.017	214.708
54	Sat			
55	Sun			
56	225.200	214.519	215.144	214.864
57	225.613	216.803	215.736	215.382
58	227.240	218.051	217.810	217.306
59	228.397	219.245	218.823	218.434
60	228.210	219.010	218.360	218.017
61	Sat			
62	Sun			
63	228.822	219.768	219.187	218.806
64	229.041	219.871	219.319	218.986
65	228.181	219.098	218.708	218.323
66	227.191	218.144	217.618	217.269
67	227.844	218.278	217.634	217.246
68	Sat			
69	Sun			
70	226.918	214.500	215.883	215.659
71	226.580	216.535	215.293	214.673
72	225.620	216.896	214.859	215.947
73	225.964	215.724	215.108	216.564
74	226.794	216.100	215.814	217.224
75	Sat			
76	Sun			
77	226.647	216.160	215.749	217.010
78	226.158	215.449	215.158	216.791

79	228.751	217.795	217.715	219.255
80	228.271	217.458	217.246	218.724
81	225.883	215.467	216.065	216.805
82	Sat			
83	Sun			
84	225.581	215.294	215.788	215.273
85	226.152	215.984	216.298	215.692
86	225.763	215.919	216.048	215.303
87	225.977	216.334	216.090	215.474
88	226.720	216.692	216.660	215.906
89	Sat			
90	Sun			
91	226.017	216.122	216.136	215.466
92	226.081	216.331	216.224	215.269
93	226.658	215.743	216.332	216.029
94	226.693	215.749	216.156	215.316
95	226.011	214.722	215.534	214.546
96	Sat			
97	Sun			
98	Holiday			
99	227.271	216.183	216.959	216.161
100	227.102	215.764	216.697	215.844
Mean	226.517	216.283	216.289	216.113
SD	1.184	1.451	1.319	1.364

Note: Sat = Saturday; SD = standard deviation; Sun = Sunday

APPENDIX C. IN-LIFE DATA

CLINICAL OBSERVATIONS

Exposure Day	Animal ID	Observation	
		Load	Unload
Control Group			
29	19	EC	EC
30	109	EC	EC
30	117	-	EC
35	15	-	EC
37	20	EC	-
38	20	EC	-
39	20	EC	-
40	20	-	EC
45	20	-	EC
46	20	EC	EC
47	20	EC	-
48	20	EC	-
49	20	EC	-
50	12	EC	-
50	20	-	EC
51	20	EC	EC
52	20	EC	EC
53	20	EC	EC
54	20	EC	EC
56	6	-	EC
56	20	EC	EC
60	6	EC	-
60	20	EC	-
61	20	EC	EC
62	20	EC	-
65	20	EC	EC
66	20	EC	-
67	20	-	EC
69	20	EC	EC
observations from 1 rat: 42%			
200 mg/m ³ Gevo (bio) ATJ SPK Exposure Group			
7	33	EC	-
8	33	EC	EC
10	33	-	EC
11	33	EC	EC
12	33	EC	EC
14	33	EC	EC
15	33	EC	-
16	33	EC	EC
18	33	EC	EC
19	33	EC	EC
21	23	EC	EC
22	23	EC	EC

30	32	EC	-
34	27	-	EC
35	27	-	EC
36	27	EC	-
41	25	-	EC
42	25	EC	EC
43	25	EC	EC
44	25	EC	-
45	22	EC	-
45	25	EC	EC
45	32	EC	-
46	25	EC	-
46	34	EC	-
49	25	EC	-
58	25	-	EC
59	32	EC	-
60	25	EC	-
62	32	EC	-
63	27	EC	EC
64	39	BP	-
65	30	EC	-
65	32	EC	-
69	25	-	EC
69	27	EC	EC
69	40	EC	-
observations from 2 rats: 59%			
700 mg/m³ Gevo (bio) ATJ SPK Exposure Group			
6	46	BW↓>5%	-
16	60	EC	-
17	50	BW↓>5%	-
26	53	EC	-
33	53	-	EC
36	53	EC	EC
37	54	EC	EC
38	54	EC	EC
39	54	-	EC
41	54	EC	EC
43	54	EC	EC
44	54	-	EC
45	54	EC	EC
46	54	EC	EC
48	54	EC	EC
49	54	-	EC
51	54	-	EC
63	50	EC	-
64	48	BW↓>5%	-
67	52	EC	-
67	53	-	EC
observations from 1 rat: 62%			
2000 mg/m³ Gevo (bio) ATJ SPK Exposure Group			
7	118	-	EC

17	68	BW↓>5%	-
18	78	-	EC
21	76	EC	-
29	73	-	EC
34	66	-	EC
35	66	-	EC
36	66	EC	EC
36	70	-	EC
37	66	EC	EC
37	70	EC	EC
38	66	EC	EC
39	66	EC	EC
39	70	-	EC
40	66	EC	EC
41	66	EC	EC
41	70	-	EC
42	66	EC	EC
42	70	EC	EC
43	66	EC	EC
43	70	EC	EC
44	66	-	EC
44	70	EC	EC
45	66	EC	EC
45	70	EC	EC
46	66	EC	EC
46	70	EC	EC
47	66	EC	EC
48	66	EC	EC
48	70	-	EC
49	66	EC	EC
49	70	-	EC
50	66	EC	EC
51	66	EC	EC
51	70	-	EC
52	66	EC	EC
52	70	EC	EC
53	66	EC	EC
53	70	-	EC
54	66	EC	EC
54	70	-	EC
55	66	EC	EC
56	66	EC	EC
56	70	-	EC
57	66	EC	EC
57	70	-	EC
58	66	-	EC
59	66	EC	EC
59	70	EC	-
60	66	EC	EC
60	68	-	EC
60	70	EC	-
61	64	BW↓>5%	-
63	66	EC	-

63	70	EC	-
65	70	-	EC
69	70	EC	EC
observations from 2 rats: 92%			
Micronucleus Control Groups			
5	138	BW↓>5%	-
11	29	EC	-

Note: All observations are normal when absent or marked by “-“; BP = bloody paw around toe; BW↓ = > 5% body weight decrease from previous exposure day; EC = eye crust; ID = identification number

BODY WEIGHTS

Control Group Body Weights

Animal #	Sex	Pre Exposure	Exposure Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9
1	M	193.23	208.83	209.25	210.68	212.37	217.16	216.77	223.6	225.96	228.48
3	M	199.05	211.87	215.15	217.1	218.96	223.58	228.3	231.25	230.24	233.39
5	M	188.45	203.03	203.99	204.22	206.75	213.72	212.24	218.15	218.29	220.77
7	M	181.46	195.18	196.19	198.41	199.55	205.8	207.7	209.53	212.88	211.54
109	M	178.8	189.69	192.3	192.91	194.59	198.82	199.7	202.26	205.88	207.52
11	M	181.73		198.3	199.29	198.95	204.89	204.11	209.48	210.54	215.23
13	M	194.56		213.02	212.18	213.04	221.96	221.95	228.22	226.62	232.64
15	M	165.59		182.81	184.13	186.3	194.96	196.76	200.42	199.55	203.57
117	M	183.87		201.03	204.59	206.12	212.41	212.78	218.46	218.56	219.18
19	M	189.12		210.5	210.26	211.49	222.07	223.16	226.09	226.74	231.04
2	F	129.77	139.68	139.59	140.1	142.05	146.17	145.64	149.26	147.41	151.3
4	F	131.41	139.59	140.21	138.12	138.92	141.06	141.16	146	144.67	147.07
6	F	118.63	128.25	127.18	128.29	130.4	134.9	137.15	138.75	138.43	140.96
8	F	119.6	128.11	128.21	129.02	130	135.27	135.47	136.05	137.31	137.73
10	F	125.48	135.2	135.06	136.62	137.33	142.06	139.36	143.75	145.77	146.49
12	F	123.48		131.03	133.57	136.97	137.28	138.4	139.85	141.11	141.86
14	F	125.94		134.1	135.78	137.03	142.44	141.96	145.08	145	147.47
16	F	126.91		136.42	139.56	139.3	142.19	144.46	146.06	146.81	149.05
18	F	131.94		138.24	137.93	137.45	142.38	141.1	143.22	146.74	144.18
20	F	121.05		130.85	131.22	133.5	135.44	136.28	139.14	139.15	143.15
All Avg Wt		155.50	167.94	168.17	169.20	170.55	175.73	176.22	179.73	180.38	182.63
Male Avg		185.59	201.72	202.25	203.38	204.81	211.54	212.35	216.75	217.53	220.34
Female Avg		125.42	134.17	134.09	135.02	136.30	139.92	140.10	142.72	143.24	144.93

Day 10	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21
233.06	232.69	234.39	237.6	237.42	244.31	246.11	247.78	248.96	251	257.46	256.44
239.65	239.97	240.11	242.02	242.65	250.57	251.26	253.95	253.85	255.5	261.69	264.87
225.53	227.56	230.28	232.18	232.68	240.23	242.44	244.85	244.8	247.33	255.85	256.83
219	219.73	221.92	224.72	227.35	231.67	233.37	236.48	234.78	237.89	244.28	245.11
213.54	214.3	217.02	218.24	220.74	224.98	227.7	228.96	232.91	233.6	242.03	240.64
219.62	221.05	222.15	223.99	225.67	230.57	230.36	232.77	231.38	234.51	238.69	239.42
236.81	238.07	238.65	239.99	238.61	245.6	247.47	248.44	249.93	252.98	259.02	261.28
210.77	213.02	215	214.79	216.75	224.63	225.89	224.06	228.73	228.95	235.16	237.7
228.03	226.49	229.46	231.59	234.01	241.28	245.46	247.43	246.98	250.49	258.49	260.14
239.56	238.43	239.52	242.33	243.62	246.42	249.3	253.37	251.82	256.31	258.61	260.08
155.11	154.95	156.02	154.82	157.7	161.31	162.13	160.82	160.41	163.09	164.13	163.34
150.88	150.23	152.42	152.18	153.88	158.76	158.64	158.36	161.26	159.58	164.35	161.85
147.01	146.4	144.78	147.59	150.02	150.89	152.17	152.62	151.42	152.9	156.78	155.53
143.23	142.58	144.41	143.97	145.27	148.6	147.28	147.38	148.64	149.39	154.5	151.33
150.02	151.09	152.83	155.71	154.51	160.64	160.75	159.83	160.28	161.68	164.27	161.51
147.33	145.25	146.34	148.46	148.28	151.53	149.96	149.25	152.2	149.17	154.19	154.71
148.78	149.92	151.7	153.79	154.7	157.13	156.37	156.44	157.8	159.11	161.26	160.93
151.5	151.38	154.71	152.15	153.89	157.33	156.28	159.25	156.41	159.4	161.38	159.01
151.22	150.1	151.27	153.17	155.85	156.19	158.12	156.73	158.04	159.28	163.61	162.54
145.47	144.59	142.56	143.79	145.16	149.25	150.78	153.7	154.61	155.64	158.23	157.6
187.81	187.89	189.28	190.65	191.94	196.59	197.59	198.62	199.26	200.89	205.70	205.54
226.56	227.13	228.85	230.75	231.95	238.03	239.94	241.81	242.41	244.86	251.13	252.25
149.06	148.65	149.70	150.56	151.93	155.16	155.25	155.44	156.11	156.92	160.27	158.84

Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34
259.33	262.67	264.92	271.16	273.06	272.8	276.9	282.79	282.6	283.77	285.28	284.95	288.38
265.6	269.33	270.33	276.76	276.38	280.69	282.7	287.45	285.95	286.18	285.09	288.09	293.85
258.49	257.56	256.85	267.22	265.53	268.43	270.02	278.86	277.4	276.38	278.02	278.26	286.62
248.72	249.89	253.3	258.13	260.12	261.16	264.68	270.19	270.58	270.59	270.4	269.3	274.18
244.33	245.29	246.8	254.08	252.37	255.28	259.3	264.05	263.83	264.54	259.05	258	263.25
240.14	242.56	243.41	251.29	251.14	253.24	256.27	261.53	262.56	265.08	263.25	266.48	268.59
261.33	259.73	261.6	268.59	270.94	269.18	275.95	281.25	279.63	280.23	282.38	282.02	288.19
240.74	238.44	240.63	248.47	249.17	251.3	254.66	259.18	261.31	261.76	262.11	261.4	268.6
259.55	260.26	262.24	268.71	266.66	266.65	270.6	276.46	274.31	275.04	277.59	278.66	283.79
263.51	267.28	264.2	270.51	268.51	272.96	274.35	275.62	279.99	282.13	282.45	283.5	285.68
168.28	165.67	166.19	170.77	167.46	170.15	171.24	173.79	173.88	175.23	175.65	174.78	176.28
163.03	160.17	162.19	165.68	163.76	164.76	166.53	169.22	167.73	167.98	167.53	167.58	171.42
155.63	158.46	159.16	160.98	159.64	161.2	162.16	165.65	165.02	163.5	162.96	165.22	166.24
153.2	153.17	154.24	157.1	156.26	158.86	159.89	159.74	159.32	160.3	160.64	160.21	165.89
163.32	164.67	164.17	165.44	166.93	168.08	169.19	174.44	172.92	172.01	173.06	173.64	175.31
153.89	152.67	155.87	158	158.78	158.64	160.8	162.55	160.62	161.19	160.8	161.48	165.76
162.24	162.06	162.07	164.48	163.89	164.98	168.72	170.09	169.71	170.85	170.27	168.86	172.63
162.58	164	162.26	166.42	163.85	161.35	163.21	165.97	169.7	165.45	167.93	169.96	169.33
164.61	164	162.41	169.56	166.99	166.66	170.16	170.7	168.13	169.76	170.74	168.91	172.12
159.55	156.76	159.85	160.95	161.51	159.43	165.02	165.46	165.78	166.78	167.26	165.67	169.49
207.40	207.73	208.63	213.72	213.15	214.29	217.12	220.75	220.55	220.94	221.12	221.35	225.28
254.17	255.30	256.43	263.49	263.39	265.17	268.54	273.74	273.82	274.57	274.56	275.07	280.11
160.63	160.16	160.84	163.94	162.91	163.41	165.69	167.76	167.28	167.31	167.68	167.63	170.45

Day 35	Day 36	Day 37	Day 38	Day 39	Day 40	Day 41	Day 42	Day 43	Day 44	Day 45	Day 46
291.83	292	293.39	295.29	300.89	304.07	301.9	304.56	303.25	310.59	307.26	309.55
292.96	293.23	293.94	297.88	302.17	302.92	304.23	303.26	305.02	309.31	309.07	309.84
287.11	287.29	286.85	288.66	295.01	294.08	295.04	296.05	297.22	303.82	302.22	303.59
277.13	277.45	276.92	277.39	283.09	283.73	284.79	283.77	283.49	288.09	289.55	289.94
266.59	265.5	267.42	267.39	274.91	272.93	277.37	278.33	278.07	282.48	282.45	283.9
271.5	272.03	271.55	271.62	277.84	276.46	278.53	280.22	279.13	281.53	283.51	286.97
290.5	291.71	289.15	291.28	299.88	297.05	299.15	300.73	299.89	306.47	305.42	308.04
269.35	266.78	270.67	270.66	273.58	276.19	275.49	277.86	278.11	283.64	284.7	286.93
283.97	282.43	285.42	284.69	289.32	291.17	293.29	294.71	291.57	299.37	298.6	301.45
287.57	285.27	284.42	289.93	288.98	291.28	291.31	291.58	293.03	298.95	298.2	299.17
178.54	179.33	175.62	177.18	182.19	181.04	181.32	181.18	183.33	184.97	184.86	183.02
170.5	171.99	173.39	171.2	176.66	175.7	176.74	176.97	176.83	177.86	178.39	177.62
166.42	168.08	168.46	167.2	171.57	169.02	169.49	168.29	165.69	169.52	167.58	167.59
163.99	163.89	164.41	166.99	168.5	167.23	168.77	167.13	166.02	168.62	167.82	169.24
175.06	178.45	176.63	175.69	181.39	178.26	178.74	182.49	183.45	186.2	185.41	183.82
163.53	165.96	165.19	164.32	169.49	168.68	165.64	167.51	168.24	166.49	167.94	168.33
173.04	171.47	173.03	169.58	174.17	174.82	174.5	174.32	173.92	181.78	180.01	179.68
168.05	172.36	167.92	169.92	172.88	171.78	172.22	171.05	170.89	172.62	169.6	172.54
172.53	172.72	174.02	171.54	175.19	174.1	173.44	173.39	173.67	175.75	174.64	176.51
170.43	166.78	166.92	169.21	170.4	171.33	169.89	169.3	170.74	175.56	169.75	172.49
226.03	226.24	226.27	226.88	231.41	231.09	231.59	232.14	232.08	236.18	235.35	236.51
281.85	281.37	281.97	283.48	288.57	288.99	290.11	291.11	290.88	296.43	296.10	297.94
170.21	171.10	170.56	170.28	174.24	173.20	173.08	173.16	173.28	175.94	174.60	175.08

Day 47	Day 48	Day 49	Day 50	Day 51	Day 52	Day 53	Day 54	Day 55	Day 56	Day 57	Day 58
309.66	311.35	316.02	315.5	318.65	319.86	315.28	323.11	322.23	323.05	322.98	323.79
311.45	314.38	315.43	316.65	317.04	318.92	321.25	324.95	327.54	327.16	325.65	325.42
302.8	304.73	310.8	310.41	311.77	313.89	313.16	319.84	318.08	317.81	318.89	321.26
288.42	291.22	292.66	297.42	294.38	293.6	295.75	300.12	299.91	300.85	300.56	304.03
284.09	285.63	288.29	288.56	289.75	289.8	290.07	294.6	292.84	293.73	294.15	294.94
285.96	288.06	293.09	292.78	290.9	294.33	295.67	300.98	299.8	298.1	300.56	301.27
309.34	309.36	315.47	315.56	314.9	314.83	317.99	322.61	321.51	323.75	324.04	325.38
286.35	287.39	295.83	293.14	293.45	297.82	298.81	304.63	302.18	304.13	304.45	302.06
301.44	302.72	305.68	304.47	304.38	306.85	306.6	309.96	308.52	306.71	307.86	308.7
301.37	302.72	304.42	304.5	307.11	304.52	309.28	311.35	311.31	309.88	309.47	311.29
183.81	184.44	191.12	186.47	186.66	186.07	188.86	193.2	189.72	190.57	191.4	189.49
179.97	180.33	183.73	182.17	181.03	184.3	182.44	184.87	182.7	185	182.28	184.74
168.26	168.65	171.28	171.54	170.35	170.53	172.5	176.96	174.21	172.7	173.46	173.69
168.99	170.02	170.82	169.3	171.9	172.77	170.97	173.78	173.08	172.24	171.09	172.49
185.33	185.06	189.43	185.42	185.89	186.76	189.85	193.97	190.59	191.31	187.98	189.28
167.31	168.85	170.9	168.74	170	168.81	171.38	172.73	171.75	171.37	171.12	172.93
178.39	178.32	181.28	178.02	179.02	177.44	177.73	180.71	177.47	179.29	179.74	177.21
175.28	171.52	174.4	174.54	171.49	175.18	169.74	175.97	171.85	173.51	173.8	178.4
175.49	173.2	178.23	177.66	176.29	174.88	176.45	180.22	175.34	177.92	177.9	175.76
170.62	170.62	177.43	175.26	174.7	176.05	177.33	177.18	179.8	174.62	178.12	177.24
236.72	237.43	241.32	240.41	240.48	241.36	242.06	246.09	244.52	244.69	244.78	245.47
298.09	299.76	303.77	303.90	304.23	305.44	306.39	311.22	310.39	310.52	310.86	311.81
175.35	175.10	178.86	176.91	176.73	177.28	177.73	180.96	178.65	178.85	178.69	179.12

Day 59	Day 60	Day 61	Day 62	Day 63	Day 64	Day 65	Day 66	Day 67	Day 68	Day 69	Day 70
329.15	330.83	330.48	333.29	327.94	334.66	333.47	333.64	318.87	330.65	336.12	334.82
330.72	332.91	333.04	332.61	331.47	335.01	335.79	336.76	338.33	333.53	338.42	336.13
324.92	325.6	324.22	323.94	323.19	327.7	326.92	331.64	330.48	330.51	336.72	336
303.51	304.99	304.9	307.63	305.9	308.01	307.09	308.91	307.91	307.51	312.97	312.23
301.72	301.82	302.46	302.62	296.64	303.41	301.79	301.82	303.21	299.07	305.05	303.87
306.58	303.4	306.18	304.88	302.11	307.57	307.83	306.27	309.66	309.78	312.33	313.74
327.5	329.28	327.89	330.41	329.02	331.52	328.82	330.3	331.79	332.47	335.05	334.73
311.43	309.05	311.71	309.86	312.45	317.72	315.18	316.95	319.28	319.11	320.51	321.96
315.18	313.29	313.07	311.56	312.52	315.1	314.85	315.87	314.12	317.29	320.57	320.12
313.42	315.33	316.36	315.39	316.09	316.69	313.59	314.98	317.22	314.35	313.31	316.37
193.6	194.41	193.56	191.45	191.65	194.05	191.46	193.5	191.53	191.82	197.13	193.04
187.84	185.92	185.54	188.2	184.09	186.59	187.27	187.81	187.71	184.27	194.63	190.21
177.81	177.78	176.52	176.46	173.79	181.17	176.25	177.11	179.35	176.11	179.25	177.98
175.09	174.39	175.26	175.07	171.76	176.6	175.17	173.66	173.63	172.61	178.75	173.71
190.88	191.45	191.79	190.82	189.62	193.48	190.8	193.91	192.7	190.09	194.93	192.43
174.75	175.16	175.43	175.08	172.66	173.24	172.83	173.22	172.83	171.79	173.41	171.09
184.74	184.59	181.04	182.92	182.86	182.02	180.29	182.33	182.07	184.39	189.63	185.92
176.95	177.06	177.77	177.45	175.76	180.2	177.94	178.71	179.52	180.67	181.15	180.72
180.5	180.06	178.75	179	178.24	180.81	176.82	178.17	178.01	180.95	183.6	184.96
177.76	177.12	175.29	177.77	181.56	177.99	176.81	177.9	182.93	179.71	181.93	179.5
249.20	249.22	249.06	249.32	247.97	251.18	249.55	250.67	250.56	250.33	254.27	252.98
316.41	316.65	317.03	317.22	315.73	319.74	318.53	319.71	319.09	319.43	323.11	323.00
181.99	181.79	181.10	181.42	180.20	182.62	180.56	181.63	182.03	181.24	185.44	182.96

200 mg/m³ Gevo (bio) ATJ SPK Exposure Group Body Weights

Animal #	Sex	Pre Exposure	Exposure Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9
21	M	196.64	208.81	207.91	209.44	212.86	220.05	216.97	220.95	221.57	223.22
23	M	189.06	202.07	203.47	206.83	209.66	212.8	215.04	216.81	220.36	220.9
25	M	182.38	191.17	189.65	190.6	194.1	198.19	198.29	199.53	204.44	206.17
27	M	194.53	210.83	212.19	214.18	213.95	222.6	224.36	228.06	231.16	234.11
129	M	193.29	207.36	207.32	210.21	211.99	221.92	218.66	223.99	225.76	228.73
31	M	190.36		207.64	209.36	214.55	223.29	223.77	228.28	228.11	233.01
33	M	196.62		213.94	216.08	218.65	226.75	227.65	232.68	235.24	237.29
35	M	200.49		217.71	220.29	222	231.34	231.58	233.57	238.3	242.97
37	M	172.32		186.53	188.79	188.64	198.56	198.38	200.7	204.14	206.06
39	M	189.83		204.54	209.61	211.9	219.14	218.54	224.19	228.9	230.77
22	F	114.24	125.08	120.92	122.56	125.16	129.15	128.16	127.61	130.59	130.06
24	F	121.49	132.91	132.15	133.53	133.58	136.93	138.81	137.45	141.12	138.88
26	F	128.23	132.65	133.16	134.35	135.58	141.12	137.49	141.05	144.72	144.21
28	F	132.87	143.08	140.61	141.59	144.73	147.79	145.73	146.8	149.42	150.07
30	F	132.02	143.51	142.33	141.06	143.53	150.76	149.17	148.44	153.47	153.44
32	F	133.75		138.45	138.55	139.89	146.38	143.98	145.28	148.42	148.33
34	F	131.72		137.1	141.57	140.66	145.35	145.58	145.36	147.66	145.71
36	F	117.55		127.47	128.21	130.03	132.61	131.25	131.48	131.92	133.75
38	F	125.02		131.33	133.58	134.46	138.38	137.27	139.28	142.06	143.94
40	F	131.63		137.65	141.97	143.47	146.78	146.98	148.03	149.76	150.9
All Avg Wt		158.70	169.75	169.60	171.62	173.47	179.49	178.88	180.98	183.86	185.13
Male Avg		190.55	204.05	205.09	207.54	209.83	217.46	217.32	220.88	223.80	226.32
Female Avg		126.85	135.45	134.12	135.70	137.11	141.53	140.44	141.08	143.91	143.93

Day 10	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21
231.79	231.33	234.04	236.05	237.37	240.81	244.06	245.03	246.01	248.05	252.25	255.06
228.42	229.35	231.7	233.83	233.24	238.77	243.46	241.97	244.4	247.38	253.11	254.38
211.89	211.46	213.07	213.3	216.29	221.31	221.66	221.31	222.65	223.81	230.43	230.31
243.77	243.26	243.6	246.49	246.57	252.18	256.62	256.24	256.18	262.53	269.29	268.9
235.66	235.26	223.78	239.27	239.14	245.51	247.62	250.79	249.17	251.28	260.44	260.28
240.99	242.49	245.61	247.61	250.96	254.9	257.2	258.95	259.83	259.54	270.39	268.44
246.03	247.03	250.84	251.52	252.6	261.18	262.35	261.05	265.19	267.73	279.01	279.65
247.11	247.32	246.03	251.31	251.81	259.77	257.78	262.34	264.13	265.98	274.4	274.1
214.21	216.1	216.79	219.56	219.2	225.75	228.23	228.76	229.87	231.49	239.97	240.55
233.7	236.65	239.96	242.75	242.03	242.36	246.95	249.02	251.06	252.81	257.49	257.6
137.41	134.78	135.51	134.88	135.28	140.63	142.29	139.83	139.43	139.6	144.61	142.13
144.68	144.75	147.12	147.01	150.07	152.6	152.82	151.42	152.75	153.98	157.46	154.8
151.19	149.04	149.27	151.42	151.96	154.73	154.65	155.31	154.79	151.93	159.89	157.81
156.92	156.09	156.03	155.33	155.77	159.49	157.84	158.58	160.1	160.48	165.85	164.69
159.63	159.71	162.16	161.88	162.67	167.01	165.9	165.86	168.77	167.67	171.26	166.99
152.63	152.86	153.77	155.09	155.51	159.38	158.27	158.84	159.28	160.36	161.63	158.92
154.15	153.34	153.13	155.73	155.31	158.02	159.1	158	158.56	159.72	164.59	166.09
142.83	140.33	141.1	143.03	142.14	146.96	147.92	145.2	147.3	147.01	152.5	151.27
149.75	149.03	151.39	153.46	153.07	154.45	152.41	153.3	152.17	153.2	156.64	155.44
159.46	158.19	156.85	159.8	160.13	166.15	165.21	164.39	166.8	165.05	169.35	170.44
192.11	191.92	192.59	194.97	195.56	200.10	201.12	201.31	202.42	203.48	209.53	208.89
233.36	234.03	234.54	238.17	238.92	244.25	246.59	247.55	248.85	251.06	258.68	258.93
150.87	149.81	150.63	151.76	152.19	155.94	155.64	155.07	156.00	155.90	160.38	158.86

Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34
258.86	257.24	257.17	263.53	263.35	263.76	266.24	271.27	272.14	271.29	271.25	273.77	276.7
254.53	254.18	256.73	261.27	260.75	261.71	266.36	270.77	272.39	273.39	273.23	274.74	277.24
233.38	233.59	237.08	240.7	241.44	241.41	244.95	249.65	251.59	250.93	251.04	251.19	257.26
270.46	270.76	273.92	285.33	284.27	286.05	285.46	295.36	296.71	298.07	298.04	297.9	306.33
264.02	262.05	263.56	268.86	271.29	270.91	277.52	281.9	280.97	280.78	282.47	285.74	287.89
270.85	273.39	275.1	280.51	283.21	281.25	284.59	290.53	291.04	289.92	291.4	291.9	294.06
284.66	283.18	288.29	293.62	293.33	296.18	296.86	302.39	305.9	306.79	307.31	308.55	313.17
275.91	276.58	277.21	282.67	284.78	286.64	288.16	292.81	294.37	297.09	298.18	298.87	304.2
242.95	244.03	245.24	250.58	252.15	253.12	255.35	261.85	262.35	261.75	261.61	264.94	269.01
262.8	261.02	264.08	268.71	271.87	274.64	275.85	279.63	280.86	282.36	283.53	287.29	290.59
142.5	144.32	142.94	147.41	148.13	148.85	150.1	153.06	150.8	150.81	150.07	152.67	152.72
156.78	154.08	155.06	158.57	157.87	157.3	161.63	160.41	162.89	160.99	162.16	161	164.16
158.2	159.08	161.63	164.81	165.75	163.95	166.15	169.52	167.83	167	168.71	168.63	174.42
162.43	164.53	164.96	169.62	167.79	167.33	171.45	172.43	172.16	173.86	172.55	172.59	178.34
172.32	170.24	170.5	177.61	176.31	177.97	183.66	181.83	180.95	184.07	181.38	180.98	186.33
162.79	162.89	161.93	165.01	165.23	164.8	168.97	169.73	169.63	168.88	171.73	170.26	173.65
165.07	167.52	167.76	171.15	171.74	170.12	172.06	174.33	174.58	174.37	174.36	176.34	179.5
152.86	151.55	152.91	152.88	154.23	155.73	159	160.14	157.99	157.27	156.9	157.55	159.62
159.09	159.63	157.4	159.2	161.75	159.62	162.62	162.12	161.2	163.65	160.8	165.23	163.37
170.83	168.68	170.56	174.39	173.45	174.55	176.6	178.42	178.6	180.41	178.11	179.63	183.82
211.06	210.93	212.20	216.82	217.43	217.79	220.68	223.91	224.25	224.68	224.74	225.99	229.62
261.84	261.60	263.84	269.58	270.64	271.57	274.13	279.62	280.83	281.24	281.81	283.49	287.65
160.29	160.25	160.57	164.07	164.23	164.02	167.22	168.20	167.66	168.13	167.68	168.49	171.59

Day 35	Day 36	Day 37	Day 38	Day 39	Day 40	Day 41	Day 42	Day 43	Day 44	Day 45	Day 46
280.77	278.73	280.23	282.62	287.73	285.55	288.63	287.89	288.79	294.7	296	293.37
280.25	277.84	277.19	278.19	284.59	285.78	284.36	285.43	285.31	291.72	290.31	290.97
260.54	259.69	260.37	261.27	263.47	262.04	266.68	266.44	266.68	268.99	271.37	270.64
304.34	303.71	304.46	308.81	311.55	308.28	316.09	315.71	316.49	320.71	320.45	322.42
290.02	289.13	289.1	291.53	299.07	297.23	294.46	299.15	298.97	307.07	305.17	305.45
295.52	298.29	296.25	298.48	306.1	304.04	308.32	308.29	308.21	314.47	312.81	312.74
313.99	314.05	317.18	317.41	319.06	324.97	323.51	323.02	324.9	328.46	331.2	329.66
305.77	305.19	308.65	308.05	312.33	313.69	314.13	316.02	317.89	323.22	321.28	322.21
270.78	271.2	271.83	273.62	276.65	276.85	277.83	279.45	280.38	284.98	284.41	285.77
289.55	292.58	291.77	290.46	295.53	292	294.45	297	297.55	301.05	299.86	300.6
155.24	155.39	154.3	152.58	159.03	155.65	155.98	154.75	156.2	157.22	155.29	156.36
161.39	163.18	161.38	163.69	165.55	165.15	166.51	163.8	166.02	167.8	165.74	165.37
171.05	170.54	167.87	168.23	171.9	169.55	169.4	166.7	168.93	173.89	170.76	174.27
178.37	175.17	174.85	175.16	177.4	176.14	176.38	178.44	177.57	177.22	179.48	177.61
186.04	186.25	187.52	186.3	188.92	188.37	189.48	188.71	189.53	190.19	189.1	189.18
172.9	173.43	173.05	176.1	175.35	174.1	176.02	176.09	177.58	179.82	177.34	180.17
177.97	179.3	180.4	180.52	180.88	181.17	181	181.77	182.28	182.09	181.47	182.25
158.37	162.01	160.39	160.4	162.73	162.42	163.05	161.72	161.91	164.41	164.38	165.29
165.45	166.14	167.01	165.02	168.71	167.29	167.72	170.94	168.76	169.43	166.62	169.89
179.17	182.89	181.59	182.15	185.93	184.19	184.86	185.11	183.17	186.37	185.65	186.23
229.87	230.24	230.27	231.03	234.62	233.72	234.94	235.32	235.86	239.19	238.43	239.02
289.15	289.04	289.70	291.04	295.61	295.04	296.85	297.84	298.52	303.54	303.29	303.38
170.60	171.43	170.84	171.02	173.64	172.40	173.04	172.80	173.20	174.84	173.58	174.66

Day 47	Day 48	Day 49	Day 50	Day 51	Day 52	Day 53	Day 54	Day 55	Day 56	Day 57	Day 58
296.75	293.85	297.51	297.57	299.76	300.66	301.09	306.79	309.57	307.89	308.72	308.23
292.17	294.05	298.04	300.45	298.04	301.47	300.7	305.27	301.88	305.69	306.97	306.09
273.03	272.73	276.28	277.61	277.87	279.44	279.13	282.95	284.29	285.13	284.43	286.38
326.47	324.37	331.24	330.85	331.52	336.35	331.78	340.13	343.68	341.91	342.64	343.48
306.08	309.2	312.07	311.23	312.08	313.83	314.64	317.84	317.54	321.08	320.93	322.54
314.63	312.55	319.08	318.52	323.85	323.64	322.84	330.01	328.22	329	329.62	330.1
330.8	331.64	335.2	338.21	338.71	339.7	337.36	340.39	343.01	344.06	340.41	343.19
322.73	321.83	326.64	328.52	331.98	330.09	330.3	338.73	335.67	336.15	337.57	337.81
285.45	285.63	288.75	291.04	291.27	292.7	292.48	296.3	298.5	297.78	299.05	301.64
303.76	301.91	303.55	305.56	307.5	308.81	307.87	309.73	311.74	313.65	310.82	311.6
156.63	157.14	160.8	162.54	160.49	161.69	160.13	164.64	162.45	162.91	163.57	165.82
166.55	164	169.9	169.04	167.9	172.88	169.39	173.24	173.3	173.53	170.17	169.76
174.05	172.84	177.83	174.97	177.03	175.58	177.29	183.22	179.35	177.1	177.99	181.11
174.93	176.52	180.23	176.85	179.17	177.31	183.36	184.1	182.8	184.59	179.56	181.72
188.45	188.46	191.16	191.06	191.45	193.24	192.65	194.18	192.33	194.22	193.03	195.33
177.68	178.82	182.83	178	182.98	182.44	183.37	184.71	183.4	183.93	187.79	186.98
183.33	183.42	184.97	182.36	183.95	184.1	183.7	187.17	183.74	183.34	186.42	187.71
165.96	164.27	169.51	168.19	169.34	168.33	169.34	171.68	168.42	170.91	171.31	171.38
169.77	167.09	170.48	170.07	170	168.8	168.46	170.8	169.38	168.25	168.85	171.89
185.24	187.25	192.4	191.54	190.92	192.38	193.15	194.58	193.51	195.85	193.91	195.84
239.72	239.38	243.42	243.21	244.29	245.17	244.95	248.82	248.14	248.85	248.69	249.93
305.19	304.78	308.84	309.96	311.26	312.67	311.82	316.81	317.41	318.23	318.12	319.11
174.26	173.98	178.01	176.46	177.32	177.68	178.08	180.83	178.87	179.46	179.26	180.75

Day 59	Day 60	Day 61	Day 62	Day 63	Day 64	Day 65	Day 66	Day 67	Day 68	Day 69	Day 70
310.93	313.75	312.71	309.45	311.36	314.98	315.7	313.27	313.76	314.98	322.87	315.24
309.95	307.69	308.25	308.16	306.5	312.68	311.6	311.16	310.46	309.61	316.28	313.2
290.77	291	291.94	291.35	291.35	291.64	292.36	291.91	294.13	292.34	297.85	295.02
347.73	351.38	350.69	353.1	349.64	353.01	353.42	354.56	356.77	352.8	361.63	355.43
324.89	326.27	330.63	327.19	326.48	329.19	328.9	330.32	331.98	328.7	337.7	330.21
336.44	334.4	337.62	335.68	336.1	338.67	337.53	338.51	340.04	339.27	345.88	344.24
347.93	350.81	351.33	348.71	354.39	352.41	352.73	355.74	356.2	356.98	360.39	362.63
343.63	342.97	345.26	340.89	344.66	346.31	346.17	348.82	349.54	348.65	356.97	353.06
309.8	307.04	309.18	306.53	309.87	311.77	311.38	311.71	310.85	313.1	317.13	316.03
315.38	315.55	315.79	319.22	314.36	324.3	320.57	321.83	323.78	321.22	328.55	325.57
169.25	166.5	167.62	165.68	166.57	169.9	167.37	165.95	167.59	164.27	170.28	165.99
172.78	171.21	171.5	170.31	168.81	171.73	168.85	171.64	171.63	169.6	173.08	168.89
183.39	182.83	182.41	178.94	180.78	184.7	178.99	182.85	182.44	180.78	184.67	177.93
184.39	181.69	181.11	183.32	179.18	182.71	181.86	181.5	187.11	183.19	188.6	181.5
198.32	198.4	198.18	195.39	195.05	200.02	197.23	199.37	200.29	197.54	204.04	195.67
190.06	188.04	189.8	186.77	187.79	189.86	188.92	189.53	193.42	192.74	193.02	189.47
189.55	190.22	188.56	191.28	188.23	190.65	188.7	188.17	188.79	189.34	188.85	187.07
174	170.43	171.76	172.18	171.58	172.29	170.84	172.19	173.65	174.29	174.97	173.36
172.89	171.48	172.94	173.41	172.72	171.61	169.84	169.46	172.34	171.72	173.96	173.44
198.47	196.15	197.1	197.62	199.21	197.19	197.53	196.25	197.53	197.97	201.56	199.64
253.53	252.89	253.72	252.76	252.73	255.28	254.02	254.74	256.12	254.95	259.91	256.18
323.75	324.09	325.34	324.03	324.47	327.50	327.04	327.78	328.75	327.77	334.53	331.06
183.31	181.70	182.10	181.49	180.99	183.07	181.01	181.69	183.48	182.14	185.30	181.30

700 mg/m³ Gevo (bio) ATJ SPK Exposure Group Body Weights

Animal #	Sex	Pre Exposure	Exposure Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9
41	M	171.87	188.66	185.56	188.87	191.38	198.92	199.89	198.07	203.49	207.17
43	M	160.15	173.94	174.6	177.25	177.64	187.87	189.97	189.9	193.28	194.53
45	M	182.89	196.87	194.73	198.65	198.55	206.46	206.53	208.35	210.63	211.77
47	M	187.41	200.91	201.77	205.59	206.87	212.85	213.13	216.57	218.3	219.57
49	M	173.1	189.55	186	189.54	188.42	196.92	196.29	198.57	202.78	202.4
51	M	181.22		199.52	201.92	202.54	211.25	212.62	215.62	217.51	217.84
53	M	174.53		189.37	192.25	194.18	201.16	204.37	203.73	207.94	210.03
55	M	194.98		208.68	212.69	214.91	219.59	218.31	222.47	224.81	226.77
57	M	180.31		195.6	197.02	198.16	204.02	201.79	207.28	212.3	213.55
59	M	201.34		218.09	222.38	221.14	233.27	235.05	234.42	239.05	241.61
42	F	126.15	130.63	132.78	133.55	132.36	135.92	138.31	136.84	138.58	138.86
44	F	139.58	150.12	148.61	150.19	151.69	153.33	155.98	155.52	157.16	157.26
46	F	135.61	143.03	140.46	142.61	144.72	148.12	137.35	149.11	152.16	153.49
48	F	145.19	152.53	154.5	156.44	156.05	160	162.71	157.1	158.64	158.9
50	F	119.12	129.85	126.08	129.49	130.82	133.92	135.21	134.35	137.47	137.14
52	F	139.23		144.27	145.72	143.77	149.51	146.54	151.05	151.68	152.47
54	F	129.3		134.82	136.27	136.78	139.53	138.25	141.6	141.89	144.72
56	F	140.01		148.32	149.41	147.83	155.05	152.84	152.33	153.66	153.62
58	F	125.82		135.19	137.35	138.91	143.69	143.22	147.35	145.6	149.09
60	F	124.6		131.63	133.2	133.22	139.9	137.12	137.45	137.66	139.24
All Avg Wt		156.62	165.61	167.53	170.02	170.50	176.56	176.27	177.88	180.23	181.50
Male Avg		180.78	189.99	195.39	198.62	199.38	207.23	207.80	209.50	213.01	214.52
Female Avg		132.46	141.23	139.67	141.42	141.62	145.90	144.75	146.27	147.45	148.48

Day 10	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21
214.11	216.5	218.69	219.43	218	226.44	226.41	226.93	230.21	230.73	236.94	235.24
204.42	205.48	208.59	209.47	210.8	216.58	220.77	220.48	221.85	221.85	228.99	232.85
220.23	218.85	222.29	224.43	224.76	230.64	232.11	236.61	239.75	238.4	245.62	249.95
225.44	229.98	231.15	232.08	234.46	244.02	244.96	244.82	247.01	249.69	256.13	256.37
211.03	216.13	217.78	218.4	218.94	226.08	228.79	227.98	231.73	234.16	241.1	237.98
224.53	226.66	227.69	229.33	230	236.07	237.97	239.92	241.86	240.03	245.62	249.65
214.54	217.13	218.58	220.93	220.7	225.09	225.31	227.96	229.25	231.19	237.47	238.77
232.59	238	238.31	239.03	240.62	245.87	247.18	249.87	251.22	251.08	258.6	259.72
218.22	219.36	222.34	223.77	224.94	228.71	231.77	231.84	233.8	234.39	240.46	241.85
246.57	249.86	249.21	253.53	255.22	263.64	265.89	267.65	265.47	273.71	281.02	282.26
145.03	144.67	143.91	146.64	148.3	150.05	150.82	152.41	154.02	153.57	156.36	159.36
165.2	162.08	162.97	164.65	167.89	166.64	168.76	168.39	167.43	169.7	174.01	173.19
156.95	159.02	161.57	159.3	161.15	166.61	166.87	168.11	169.94	169.34	172.53	172.99
165.78	167.76	170	169.85	171.21	172.84	173.06	175.64	176.51	176.88	180.8	181.83
140.6	141.82	143.84	142.71	143.91	147.01	148.96	141.21	149.28	151.06	153.05	154.28
159.14	158.27	159	160.27	159.73	161.39	162.12	161.46	163.71	162.87	167.78	164.54
149.45	150.67	151.88	151.33	152.19	155.19	155.24	156.12	154.54	152.67	156.63	154.99
163.77	162.5	164.1	163.33	163.57	166.7	166.01	167.11	167.37	170.36	174.72	176.1
154.15	154.44	157.82	158.4	158.27	162.32	162.74	161.2	164.21	165.34	166.18	165.39
146.4	148.21	148.6	148.85	151.11	153.86	153.65	153.19	155.39	155.06	156.86	157.92
187.91	189.37	190.92	191.79	192.79	197.29	198.47	198.95	200.73	201.60	206.54	207.26
221.17	223.80	225.46	227.04	227.84	234.31	236.12	237.41	239.22	240.52	247.20	248.46
154.65	154.94	156.37	156.53	157.73	160.26	160.82	160.48	162.24	162.69	165.89	166.06

Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34
237.46	239.74	238.13	243.42	246.49	247.04	248.24	254.92	255.26	257.01	256.17	256.97	259.69
234.12	235.17	237.57	242.36	243.24	245.87	248.11	254.16	256.32	255.15	255.11	258.02	260.63
250.58	254.12	252.37	258.67	259.35	256.14	261.54	265.08	263.49	268.68	264.32	267.25	272.14
254.9	258.34	260.58	267.08	268.2	267.09	270.47	274.36	275	277.1	274.84	278.19	279.74
243.63	244	245.53	250.48	252.12	253.5	255.13	262.64	262.5	262.87	268.03	268.94	270.76
251.27	251.23	253.74	259.56	260.45	258.34	264.05	268.14	271.85	269.97	273.93	271.25	274.95
240.55	242.5	241.47	247.63	247.62	248.76	251.45	254.99	256.35	257.54	257.72	257.71	262.46
261.23	264.64	264.66	271.67	269.71	274.6	276.28	282.22	284.67	285.9	283.63	288.19	292.89
241.98	243.21	243.26	250.65	251.82	254.15	254.53	260.46	261.1	260.6	260.09	261.12	264.04
283.88	288.46	284.46	293.16	296.64	294.31	300.64	301.93	303.13	303.04	306.76	304.58	311.24
159.86	161.31	161.65	163.2	165.21	166.23	168.28	171.2	170.36	169.83	172.5	171.56	175.03
173.81	173.92	173.82	177.85	177.31	177.45	180.39	182.17	181.77	181.13	182.03	181.92	186.69
173.64	174.59	177.05	180.49	177.67	182.18	183.73	184.18	183.92	187.79	187.16	184.52	188.39
180.04	182.15	184.22	185.69	185.44	187.93	190.55	191.41	192.75	191.9	190.88	194.7	197.2
155.52	154.05	154.96	157.52	157.43	159.32	158.37	161.67	159.17	159.62	162.04	162.03	163.92
165.4	168.1	168.81	170.22	170.05	172.37	172.27	174.16	175.12	175.74	174.1	175.76	176.66
156.83	158.51	158.98	161.23	161.09	162.61	161.6	161.68	164.65	163.72	163.13	164.15	166.43
172.7	175.89	176.18	177.81	178.04	180.29	180.87	181.61	183.29	180.23	180.81	185.07	183.78
166.91	167.17	168.85	171.93	171.09	171.5	175.46	175.9	174.62	173.44	173.83	175.8	177.4
157.81	156.73	159.4	162.62	160.72	161.93	164.26	165.65	164.83	164.33	164.6	164.96	166.83
208.11	209.69	210.28	214.66	214.98	216.08	218.31	221.43	222.01	222.28	222.58	223.63	226.54
249.96	252.14	252.18	258.47	259.56	259.98	263.04	267.89	268.97	269.79	270.06	271.22	274.85
166.25	167.24	168.39	170.86	170.41	172.18	173.58	174.96	175.05	174.77	175.11	176.05	178.23

Day 35	Day 36	Day 37	Day 38	Day 39	Day 40	Day 41	Day 42	Day 43	Day 44	Day 45	Day 46
259.13	262.72	261.44	259.7	265.43	264.53	265.21	266.18	264.34	270.53	271.43	271.88
261.75	264.78	264.46	265.43	271.07	271.92	273.57	273.35	274.47	277.22	279.55	279.78
274.67	273.23	272.84	276.3	279.34	281.19	283.04	282.08	280.43	286.73	287.78	288.2
280.44	283.56	278.97	281.71	287.49	288.91	290.61	292.52	290.37	295.01	294.71	297.38
273.33	269.69	275.1	272.32	277.46	275.56	277.54	278.08	280.1	279.5	279.74	283.39
273.56	278.36	274.4	277.66	283.96	282.34	282.87	284.71	286.31	290.06	290.13	291.64
261.99	264.03	263.33	266.52	270.2	271.12	272.96	271.14	273.43	275.62	276.14	277.16
294.41	296.58	297.55	295.85	305.76	303.33	304.97	303.65	305.68	312.4	310.08	311.81
262.86	264.99	267.3	267.99	270.17	270.07	274.45	274.13	277.11	279.64	281.03	282.97
307.52	311.16	309.29	314.38	317.77	320.36	318.93	320.31	323.54	326.09	324.84	326.22
175.06	176.32	175.85	175.12	177.25	177.71	175.93	178.41	177.84	180.33	179.37	178.7
185.92	187.28	187.94	188.17	189.5	190.36	188.92	191.24	190.23	193.62	192.84	192.3
187.34	188.46	189.38	187.99	195.34	192.12	190.72	194.87	192.62	194.29	195.88	195.64
198.65	198.63	198.28	197.27	198.35	198.14	199.05	199.5	199.54	201.03	200.12	199.51
165.59	164.63	165.47	165.36	168.2	166.78	167.61	167.04	168.45	168.85	168.77	171.57
177.93	179.18	178.3	177.65	180.78	177.56	180.61	179.01	180.26	182.4	179.97	182.17
165.44	167.79	166.05	166.7	168.69	168.74	170.34	167.39	168.51	169.73	170.36	168.44
181.7	183.97	184.86	186.47	185.2	190.18	187.45	190.4	187.64	188.59	189.08	187.56
175.93	175.37	177.06	175.23	181.81	181.1	178.63	180.62	180.46	180.04	178.74	178.49
166.44	165.4	164.95	165.96	170.53	168.96	168.32	167.46	169.71	172.38	170.73	171.97
226.48	227.81	227.64	228.19	232.22	232.05	232.59	233.10	233.55	236.20	236.06	236.84
274.97	276.91	276.47	277.79	282.87	282.93	284.42	284.62	285.58	289.28	289.54	291.04
178.00	178.70	178.81	178.59	181.57	181.17	180.76	181.59	181.53	183.13	182.59	182.64

Day 47	Day 48	Day 49	Day 50	Day 51	Day 52	Day 53	Day 54	Day 55	Day 56	Day 57	Day 58
273.64	274.35	278.88	277.01	278.47	279.22	281	284.53	284.81	285.13	287.18	286.27
280.56	282.72	288.16	289.08	289.49	290.36	292.69	296.27	295.38	295.25	298.2	296.11
288.26	287.78	292.34	291.76	294.65	294.87	296.63	298.31	299.27	298.7	297.62	299.1
298.29	298.83	307.76	306.62	305.31	311.33	313.14	312.41	313.65	311.87	313.38	315.61
283.48	283.67	290.13	290.53	288.4	289.48	292.3	293.62	293.57	292.74	297.19	295.8
291.18	292.84	295.36	293.07	294.89	294.23	295.06	300.84	298.31	300.77	297.19	298.3
276.25	276.95	281.7	281.49	281.66	282.2	284.19	288.47	285.18	286.79	287.28	290.11
311.78	312.96	317.14	316.73	319.41	320.88	322.85	329.06	327.94	325.93	326.74	331.62
282.64	284.3	288.47	289.36	288.41	291.1	293.88	297.24	297.62	297.82	297.62	299.43
329.2	332.37	333.64	337.74	338.42	336.09	335.73	343.27	341.65	344.43	347.44	346.65
180.18	179.03	180.7	180.5	177.92	179.43	179.73	181.59	179.48	179.56	181.15	182.7
191.49	192.27	196.76	195.06	193.44	196.23	197.47	195.71	195.68	196.59	196.2	197.29
196.99	196.09	197.09	196.82	197.09	197.45	197.44	202.54	198.41	200.73	199.75	202.37
199.83	199.55	202.3	203.18	202.75	204.87	201.4	203.92	206.57	204.8	203.25	205.98
169.8	170.09	171.88	171.57	173	172.25	171.84	174.08	173.03	171.39	173.35	174.08
182.42	180.65	185.15	184.1	183.79	185.74	184.13	187.06	186.48	184.91	186.19	187.96
169.82	169.26	172.65	173.11	172.35	173.75	173.46	173.5	173.04	174.17	174.43	176.99
187.91	193.28	194.19	192.38	197.05	195.55	192.38	197.23	193.07	193.08	194.87	193.28
180.64	180.57	184.65	183.8	184.7	182.7	183.27	186.58	186.68	186.51	183.27	183.57
172.08	171.87	175.45	174.55	174.23	173.59	175.44	178.05	177.37	176.77	175.37	175.48
237.32	237.97	241.72	241.42	241.77	242.57	243.20	246.21	245.36	245.40	245.88	246.94
291.53	292.68	297.36	297.34	297.91	298.98	300.75	304.40	303.74	303.94	304.98	305.90
183.12	183.27	186.08	185.51	185.63	186.16	185.66	188.03	186.98	186.85	186.78	187.97

Day 59	Day 60	Day 61	Day 62	Day 63	Day 64	Day 65	Day 66	Day 67	Day 68	Day 69	Day 70
290.15	290.76	293.96	293.33	291.54	293.39	293.25	292.18	295.49	293.82	297.8	292.75
302.53	304.86	305.02	305.37	305.31	306.91	308.32	309.58	310.49	308.82	315.93	310.6
300.33	301.49	305.5	304.56	304.38	306.85	308.04	305.84	309.49	303.63	310.3	308.08
319.21	320.87	318.55	318.06	320.2	324.01	321.64	324.22	325.13	324.99	328.89	323.43
299.7	300.05	300.23	301.82	296.87	304.77	302.22	302.55	302.4	302.84	307.57	307.66
303.91	303.82	302.73	306.13	305.99	309.56	307.15	308.02	305.8	309.57	314.1	311.87
292.75	291.97	292.55	295.39	296.61	298.6	298.7	298.64	298.82	298.78	301.64	303.18
336.08	336.97	339.23	336.42	338.02	342.19	340.84	340.74	344.42	343.35	346.64	345.41
301.31	300.32	304.01	299.04	305.15	303.74	304.09	304.22	301.92	304.32	304.9	306.06
349.3	350.66	350.7	349.02	353.38	355.12	356.37	354.28	354.03	355.77	361.91	360.1
184.38	185.68	184.47	182.03	184.87	185.26	183.81	185.24	184.43	184.81	188.58	182.86
202.72	200.55	201.65	204.04	201.67	202.95	202.29	206	205.61	203.26	207.95	203.15
205.63	202.78	204.16	203.37	201.82	205.14	203.28	201.74	204.14	203.25	205.2	201.81
208.1	207.62	207.99	203.28	208.6	188.93	204.63	206.48	205.75	204.06	207.96	204.46
175.57	176.13	175.07	175.09	172.53	176	173.9	176.82	173.74	177.86	180.26	178.46
188.08	188.33	188.5	189.44	188.46	192.56	188.73	191.76	188.92	189.2	191.29	187.64
177.47	175.63	175.33	175.68	174.86	176.36	176.32	176.87	173.93	175.02	179.78	179.07
197.38	194.32	195.17	199.74	196.77	194.18	194.21	199.26	197.86	195.6	199.79	201.9
189.17	185.44	187.42	187.51	185.63	190.6	189.46	188.66	188.72	189.58	192.72	189.69
179.5	177.68	169.03	176.84	175.68	180.13	178.4	181.41	179.73	182.36	185.14	181.53
250.16	249.80	250.06	250.31	250.42	251.86	251.78	252.73	252.54	252.54	256.42	253.99
309.53	310.18	311.25	310.91	311.75	314.51	314.06	314.03	314.80	314.59	318.97	316.91
190.80	189.42	188.88	189.70	189.09	189.21	189.50	191.42	190.28	190.50	193.87	191.06

2000 mg/m³ Gevo (bio) ATJ SPK Exposure Group Body Weights

Animal #	Sex	Pre Exposure	Exposure Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9
61	M	185.13	200.22	200.28	203.58	204.73	211.04	214.85	217.35	220.64	220.72
63	M	171.79	185.79	185.73	188.5	189.27	197.46	196.18	199.82	201.76	206.66
65	M	196.13	209.39	210.79	213.44	213.29	220.22	220.05	224.21	227.9	228.72
135	M	186.98	203.16	205.35	206.39	209.47	215.55	218.42	217.91	217.8	220.93
69	M	187.07	207.01	208.1	213.5	215.58	224.62	227.07	229.81	234.65	237.33
71	M	190.15		207.17	210.89	211.23	220.99	221.57	221.96	227.56	227.59
73	M	183.86		200.38	204.58	201.77	211.44	209.46	211.57	215.38	218.22
75	M	187.02		204.78	206.34	210.64	217.33	219.48	222.71	224.21	228.26
77	M	186.27		202.47	203.23	204.27	209.37	210.43	211.79	213.52	218.5
79	M	206.48		222.94	226.58	229.78	240.23	237.94	238.36	243.01	245.56
62	F	134.67	149.25	149.83	149.73	150.7	154.53	154.96	156.22	157.01	156.18
64	F	119.47	126.92	127.87	129.01	127.81	132.77	131.39	132.34	133.81	133.54
66	F	121.42	133	131.63	132.7	132.68	139.06	137.25	139.99	141	140.75
68	F	109.65	117.68	117.69	119.24	119.09	122.47	121.23	121.55	121.8	121.79
70	F	128.32	134.74	134.83	134.62	133.51	139.3	137.44	138.78	138.21	140.15
72	F	120.75		126.94	129.85	131.4	136.06	134.46	135.37	138.76	140.31
74	F	130.21		138.23	141.24	142.58	149.37	146.92	148.5	148.57	152.3
76	F	130.94		138.16	137.93	139.39	147.61	145.38	145.81	147.91	146.84
78	F	134.42		139.39	143.07	143.35	151.54	147.6	146.69	149.22	151.33
80	F	123.8		130.81	133.22	136.33	138.67	137.93	140.59	142.35	143.24
All Avg Wt		156.73	166.72	169.17	171.38	172.34	178.98	178.50	180.07	182.25	183.95
Male Avg		188.09	201.11	204.80	207.70	209.00	216.83	217.55	219.55	222.64	225.25
Female Avg		125.37	132.32	133.54	135.06	135.68	141.14	139.46	140.58	141.86	142.64

Day 10	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21
228.26	229.07	230.6	232.49	235.02	239.94	244.62	245.17	249.03	249.24	256.9	257.82
211.56	215.23	214.54	215.02	219.03	217.21	222.61	219.1	217.45	228.09	234.17	234.49
231.21	234.37	234.37	236.55	237.01	242.49	245.06	244.67	248.02	250.31	254.79	256.53
228.12	228.66	231.33	229.88	233.55	236.54	239.18	241.38	241.48	242.31	248.62	252.16
246.68	247.77	250.32	251.61	255.55	262.01	263.75	266.39	268.75	267.42	280.16	282.48
233.27	236.14	236.14	239.35	239.23	240.85	244.79	246.5	248.24	249.87	261.4	259.48
224.91	226.12	226.14	228.44	228.92	234.36	234.09	237.67	237.37	240.8	246.14	248.44
233.33	237.34	237.96	241.22	242.19	246.89	251.56	254.53	256.06	254.88	262.79	265
222.78	227.62	225.58	226.66	228.71	235.47	234.88	234.42	236.55	237.43	243.52	242.69
250.6	252.28	252.45	254.51	258.43	262.39	264.89	263.58	267.21	269.65	277.75	279.1
166.01	162.94	164.75	164.68	165.02	168.26	169.31	167.48	168.52	170.05	175.44	175.2
138.99	139.88	141.43	140.9	142.5	145.64	144.17	145.69	146.79	145.75	149.78	148.16
148.35	149.44	148.96	150.17	148.7	153.85	155.77	153.88	154.75	150.83	154.37	157.68
127.84	131.46	130.62	129.68	128.22	132.6	134.83	126.68	134.63	135.06	140.26	138.86
143.82	144.1	143.07	145.87	146.22	146.6	149.51	148.19	147.86	148.51	154.47	152.4
144.03	143.58	145.41	147.72	146.56	147.97	149.35	149.33	149.33	150.96	154.7	152.63
152.37	154.04	155.45	156.49	157.54	159.74	158.32	155.36	157.13	158.35	163.24	161.96
152.77	153.59	152.72	153.68	155.11	158.77	160.71	156.23	159.85	159.74	163.5	163.42
154.92	156.37	155.49	157.54	156.94	162.37	162.34	160.38	162.18	162.28	168.62	168.96
149.42	146.36	148.94	148.76	148.8	154.37	153.01	154.46	156	154.87	158.8	158.32
189.46	190.82	191.31	192.56	193.66	197.42	199.14	198.55	200.36	201.32	207.47	207.79
231.07	233.46	233.94	235.57	237.76	241.82	244.54	245.34	247.02	249.00	256.62	257.82
147.85	148.18	148.68	149.55	149.56	153.02	153.73	151.77	153.70	153.64	158.32	157.76

Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34
264.24	265.75	263.13	269.03	273.61	271.55	274.36	279.81	280.66	280.39	281.5	282.75	286.51
237.29	236.38	238.68	246.37	248.23	249.24	252.53	256.31	255.73	254.08	257.65	256.75	262.14
257.62	260.75	260.67	263.42	264.96	269.58	270.76	274.21	274.15	278.59	275.54	278.86	278.78
253.68	255.2	256.43	266.83	268.13	269.19	270.27	278.63	281.52	280.78	279.8	281.5	283.8
284.14	286.1	287.5	296.62	298.4	301.49	301.06	308.53	311.04	313.25	312.11	317.33	318.76
265.04	264.85	266.55	273.07	274.11	275.17	281.64	282.55	285.56	285.29	289.94	286.56	290.94
250.05	249.07	250.6	256.3	252.07	256.52	260.06	262.83	265.2	268.7	265.9	269.38	273.65
267.68	267.41	269.02	275.67	275	279.63	281.91	284.98	289.03	287.96	290	289	293.83
244.51	245.63	245.75	250.81	252.57	253.92	256.5	261.69	264.16	263.59	265.87	266.23	269.54
279.21	282.27	284.62	290.15	294.1	294.15	297.62	303.79	304.21	303.28	304.48	307.82	311.58
177.14	176	175.61	179.43	179.74	179.47	183.11	184.98	183.02	184.03	183.1	182.95	188
150.53	150.57	149.34	152.52	153.07	151.9	154.5	157.65	156.07	156.8	158.66	156.12	160.59
159.29	159.95	160.8	165.18	165.22	164.93	167.21	165.56	166.81	166.85	164.78	166.64	170.29
139.77	139.37	140.18	141.69	142.76	141.57	144.49	145.78	145.36	148.02	146.84	146.11	149.28
153.17	154.6	154.92	158.34	156.94	159.64	161.62	162.54	164.21	162.46	163.68	164.08	166.09
154.95	155.58	155.41	155.98	156.96	157.45	159.61	164.32	161.04	162.84	159.88	162.29	163.5
163.85	163.57	163.68	165.32	166.04	167.32	168.4	170.46	168.34	168.93	170.37	170.69	170.37
163.73	165.21	163.15	165.18	166.43	166.55	169.32	171.75	169.92	169.29	171.94	171.37	173.21
167.89	170.19	169	173.41	173.61	174.79	179.2	178.61	177.15	180.32	178.91	179.65	181.25
159.83	159.46	159.27	161.64	163.98	162.45	165.68	167.19	166.75	167.24	166.18	167.14	171.26
209.68	210.40	210.72	215.35	216.30	217.33	219.99	223.11	223.50	224.13	224.36	225.16	228.17
260.35	261.34	262.30	268.83	270.12	272.04	274.67	279.33	281.13	281.59	282.28	283.62	286.95
159.02	159.45	159.14	161.87	162.48	162.61	165.31	166.88	165.87	166.68	166.43	166.70	169.38

Day 35	Day 36	Day 37	Day 38	Day 39	Day 40	Day 41	Day 42	Day 43	Day 44	Day 45	Day 46
290.42	288.47	290.74	293.58	294.78	296.31	301.94	295.31	297.19	302.84	305.49	301.77
262.53	263.12	260.21	264.36	269.24	269.17	272.47	268.57	271.24	275.43	277.4	276.53
284.78	285.71	286.76	284.32	292.34	292.74	292.97	294.74	293.43	299.66	298.36	300.59
286.84	284.57	287.56	287.55	291.93	291.32	293.01	295.92	295.9	301.35	303.28	304.89
322.71	322.2	322.25	323.7	329.21	332.73	331.64	331.83	333.95	340.37	342.38	340.55
294.33	296.77	296.86	301.09	305.05	303.55	306.81	308.87	309.74	315.27	313.27	315.7
277.65	276.71	277.85	279.9	283.66	283.26	285.99	284.59	287.72	288.03	291.75	292.7
297.69	301.03	301.63	298.71	304.8	304.42	307.03	306.82	308.43	310.57	312.23	313.95
269.08	271.95	270.84	271.96	274.06	277.71	278.36	278.7	278.02	282.39	283.42	282.67
314.14	314.51	316.24	315.17	321.47	322.27	321.62	325.73	328.38	331.8	331.09	332.73
184.42	186.23	187.26	186.13	189.17	190.48	189.83	189.37	189.64	194.28	192.84	194.47
158.83	160.01	159.83	159.86	163.84	162.71	162.85	162.18	164.23	167.37	161.69	165.26
170.93	171.23	171.03	171.4	171.87	171.03	170.88	172.17	171.44	173	173.96	172.8
151.37	149.56	149.07	152.48	150.93	152.02	153.99	153.09	154.02	155.37	155.85	155.7
165.92	166.62	166.56	168.88	166.66	167.39	168.08	167.9	168.28	169.12	167.94	168.05
161.85	164.8	163.2	161.63	166.11	165.52	165.23	165.12	165.69	167.66	167.1	169.11
170.03	171.18	171.36	173.14	175.22	174.48	175	174.38	173.56	175.25	174.26	176.61
171.87	172.3	172.49	171.87	175.16	175.97	177.17	178.64	175.22	181.48	180.54	178
181.45	180.77	180.07	180.17	184.21	183.62	180.45	184.46	183.15	183.21	183.84	186.04
168.08	168.15	166.56	167.93	170.55	170.54	172.11	171.14	171.14	174.69	176.14	175.72
229.25	229.79	229.92	230.69	234.01	234.36	235.37	235.48	236.02	239.46	239.64	240.19
290.02	290.50	291.09	292.03	296.65	297.35	299.18	299.11	300.40	304.77	305.87	306.21
168.48	169.09	168.74	169.35	171.37	171.38	171.56	171.85	171.64	174.14	173.42	174.18

Day 47	Day 48	Day 49	Day 50	Day 51	Day 52	Day 53	Day 54	Day 55	Day 56	Day 57	Day 58
305.04	306	312.83	313.8	313.53	317.04	319.35	318.54	317.18	321.57	317.62	320.58
275.99	276.01	282.03	280.04	283.14	284.92	287.59	281.95	287.6	287.92	284.9	288.6
303.02	301.97	306.97	307.59	306.94	307.9	309.52	314.13	315.69	313.59	311.87	316.26
306.24	304.01	310.64	311.61	308.87	314.02	316.48	319.51	321.43	321.13	319.54	322.47
344.12	344.33	345.33	347.12	346.36	348.03	351.05	354.14	355.84	353.81	356.02	357.89
317.52	321.23	320.76	322.55	328.81	328.6	328.74	333.11	331.6	337.69	336.04	338.77
293.58	291.59	295.65	294.82	294.86	296.52	295.3	302.43	299.51	302.12	301.08	302.27
312.73	313.61	318.54	318.34	318.53	320	322.91	326.61	325	328.52	325.03	325.54
284.07	286.08	289.59	291.9	294.61	294.81	294.8	300.8	300.46	302.61	301.49	301.77
331.55	333.79	339.37	339.76	342.78	339.6	343.02	348.98	347.43	348.96	346.39	349.58
194.09	193.18	196.32	196.41	195.74	195.1	195.75	199.4	197.2	196.13	197.72	197.21
163.94	165.64	164.45	166.98	165.88	166.21	168.45	170.48	169.09	169.81	171.32	171.82
175.88	172.46	179.23	177.6	175.59	177.23	177.87	180.51	177.97	178.66	177.98	180.11
154.29	154.35	158.54	156.98	156.46	159.19	157.03	159.49	160.37	158.02	158.7	157.64
166.68	167.45	169.2	167.61	170.1	169.67	169.68	171.75	169.93	169.03	171.59	171.2
168.91	167.48	170.06	170.97	170.32	171.09	170.57	173.32	172.51	174.28	173.81	174.28
176.5	175.55	176.8	178.89	178.69	180.21	179.09	181.67	181.74	180.09	181.19	180.26
181.23	182.17	181.92	179.89	180.7	180.04	181.76	182.98	181.75	182.95	180.2	181.66
187.28	187.93	190.11	189.74	189.48	187.54	191.37	192.16	191.22	194.32	190.53	191.91
175.37	175.2	175.31	177.47	175.76	176.56	179.04	181.32	181.45	180.54	180.63	179.13
240.90	241.00	244.18	244.50	244.86	245.71	246.97	249.66	249.25	250.09	249.18	250.45
307.39	307.86	312.17	312.75	313.84	315.14	316.88	320.02	320.17	321.79	320.00	322.37
174.42	174.14	176.19	176.25	175.87	176.28	177.06	179.31	178.32	178.38	178.37	178.52

Day 59	Day 60	Day 61	Day 62	Day 63	Day 64	Day 65	Day 66	Day 67	Day 68	Day 69	Day 70
328.15	327.84	326.07	330	324.53	328.84	327.45	328.06	330.19	325.36	332.46	333.69
294.91	292.6	296.44	294.24	297	301.38	296.85	299.61	296	292.78	301.91	303.81
322.29	320.75	318.96	320.72	316.54	326.72	325.12	325.33	325.89	322.44	329.14	326.41
329.52	326.53	330.91	329.73	327.3	331.04	328.09	332.49	329.38	331.42	334.87	330.37
363.87	364.47	364.94	363.91	363.95	368.15	368.69	368.27	368.94	369.23	376.75	370.81
340.05	342.22	344.21	338.32	342.7	341.8	342.48	345.09	344.82	344.12	350.03	345.6
307.61	310.34	310.05	307.66	310.3	310.7	308.9	312.51	313.19	314.55	317.51	318.42
329.84	332.26	333.77	333.18	331.89	334.2	332.34	337.55	338.34	338.48	338.97	343.11
305.37	307.35	307.93	307.56	308.33	311	310.89	309.83	310.57	311.04	315.08	316.5
350.56	354.16	354.12	354.84	352.48	353.7	355.68	356.19	355.21	357.13	357.53	357.65
201.46	201.15	200.54	199.46	200.08	199.62	199.21	199.12	198.96	198.24	201.8	200.74
174.92	173.92	164.33	174.97	172.93	173.89	174.28	176.57	175.98	174.95	177.89	177.05
183.79	183.21	181.97	182.5	180.66	185.3	182.68	182.99	183.75	182.83	189.82	186.66
160.71	162.05	159.98	160.68	162.72	159.55	158.18	160.39	159.12	157.88	161.91	157.38
174.63	172.92	175.01	176.73	173.41	175	174.04	172.88	173.84	174.58	173.04	174.1
174.54	174.5	175.45	173.61	173.62	174.57	171.58	173.29	172.81	175.76	175.29	175.09
185.15	184.13	183.29	184.7	185.37	184.04	184.22	183.83	184.08	186.41	185.15	182.97
182.38	180.58	181.69	182.3	182.46	186.24	181.01	183.28	183.9	184.48	185.96	186.62
196.99	192.68	195.97	198.03	195.22	197.68	197.85	195.68	197.45	194.32	200.62	198.67
185.74	182.3	183.33	185.49	184.87	182.88	180.49	181.21	184.37	184.22	186.08	182.55
254.62	254.30	254.45	254.93	254.32	256.32	255.00	256.21	256.34	256.01	259.59	258.41
327.22	327.85	328.74	328.02	327.50	330.75	329.65	331.49	331.25	330.66	335.43	334.64
182.03	180.74	180.16	181.85	181.13	181.88	180.35	180.92	181.43	181.37	183.76	182.18

Food Consumption: Week 1

All Food weights include the weight of the feeder the food (in grams)

Day		Monday			Tuesday			Wednesday			Thursday			Friday			Saturday		Sunday		Monday	
Date		5/27/2013			5/28/2013			5/29/2013			5/30/2013			5/31/2013			6/1/2013		6/2/2013		6/3/2013	
ID	Group	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Weekend & Holiday		Food Out	Weekend Consumption		
1	C				805.53	789.17	16.36	789.17	772.78	16.41	772.78	755.15	17.61	755.15	737.27	17.88			786.66	45.56		
2	C				882.39	880.4	1.98	880.4	874.56	5.85	874.56	863.89	10.67	863.89	857.34	6.55			848.3	29.04		
3	C				712.14	697.56	14.55	697.56	681.25	16.3	681.25	665.23	16.06	665.23	650.7	14.53			794.39	40.82		
4	C				880.29	870.76	9.53	870.76	863.44	7.32	863.44	853.24	10.2	853.24	843.04	10.2			869.73	25.92		
5	C				796.36	783.95	12.41	783.95	767.84	16.11	767.84	752.58	15.26	752.58	737.32	15.26			809.74	44.02		
6	C				840.04	832.3	7.71	832.3	823.56	8.77	823.56	812.14	11.42	812.14	800.72	11.42			841.45	25.5		
7	C				794.28	782.24	12.04	782.24	767.24	15	767.24	752.17	15.07	752.17	737.1	15.07			795.83	39.81		
8	C				809.42	799.38	10.04	799.38	790.19	9.19	790.19	780.77	9.42	780.77	771.35	9.42			784.1	28.56		
9	C				796.28	781.75	14.49	781.75	766.57	15.22	766.57	752.13	14.46	752.13	737.67	14.46			828.72	41.21		
10	C				793.73	785.54	8.09	785.54	775.95	9.59	775.95	766.15	9.8	766.15	756.35	9.8			783.49	27.83		
11	C				783.14	768.37	14.77	768.37	754.75	13.62	754.75	741.13	13.62	741.13	727.51	13.62			811.37	83.11		
12	C				691.04	679.5	11.56	679.5	668.67	10.87	668.67	657.8	10.87	657.8	646.93	10.87			739.17	29.06		
13	C				633.42	616.45	16.96	616.45	600.7	15.75	600.7	585.95	14.75	585.95	571.2	14.75			776.15	43.66		
14	C				643.54	632.99	10.57	632.99	622.57	10.42	622.57	612.15	10.42	612.15	601.73	10.42			706.76	29.88		
15	C				742.78	728.85	13.96	728.85	714.89	13.89	714.89	701.0	13.89	701.0	687.11	13.89			797.29	25.83		
16	C				785.8	775.84	9.99	775.84	765.84	9.99	765.84	755.84	9.99	755.84	745.84	9.99			792.49	47.36		
117	C				670.9	654.18	16.72	654.18	638.74	15.44	638.74	623.3	15.44	623.3	607.86	15.44			792.49	47.36		
118	C				782.3	774.45	8.11	774.45	766.57	8.11	766.57	758.7	8.11	758.7	750.81	8.11			796.32	37		
119	C				726.27	711.94	14.31	711.94	697.77	14.21	697.77	683.56	14.21	683.56	669.35	14.21			806.13	46.06		
20	C							709.25	698.75	10.47	698.75	688.28	11.5	688.28	677.78	10.47			786.16	32.81		
Average Consumption								10.72			12.40			12.81					11.95			

Day		Monday			Tuesday			Wednesday			Thursday			Friday			Saturday		Sunday		Monday	
Date		5/27/2013			5/28/2013			5/29/2013			5/30/2013			5/31/2013			6/1/2013		6/2/2013		6/3/2013	
ID	Group	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Food In	Food Out	Consumed	Weekend & Holiday		Food Out	Weekend Consumption		
21	L				730.82	716.89	13.93	716.89	701.62	15.27	701.62	686.35	15.27	686.35	671.08	15.27			803.45	40.91		
22	L				787.98	781.2	6.78	781.2	771.13	10.09	771.13	761.08	10.09	761.08	751.03	10.09			819.73	26.07		
23	L				686.15	680.28	16.07	680.28	663.96	16.32	663.96	647.64	16.32	647.64	631.32	16.32			769.02	41.76		
24	L				761.34	751.49	9.85	751.49	741.65	10.44	741.65	731.74	9.91	731.74	721.83	9.91			803.62	28.61		
25	L				726.43	716.63	9.8	716.63	706.83	9.8	706.83	697.03	9.8	697.03	687.23	9.8			772.48	39.32		
26	L				779.77	771.12	8.65	771.12	762.41	8.71	762.41	753.71	8.71	753.71	745.01	8.71			819.52	26.34		
27	L				657.68	642.36	15.32	642.36	627.05	15.31	627.05	611.74	15.31	611.74	606.43	15.31			776.69	46.17		
28	L				689.25	685.74	3.51	685.74	678.07	7.67	678.07	669.08	11.99	669.08	660.09	11.99			786.58	30.97		
129	L				769.45	757.28	12.19	757.28	742.16	15.1	742.16	727.93	14.23	727.93	713.7	14.23			822.11	44.19		
30	L				619.1	609.37	9.73	609.37	600.03	9.34	600.03	589.78	10.25	589.78	579.53	10.25			750.52	31.43		
31	L							740.42	729.01	11.46	729.01	711.85	17.13	711.85	704.72	17.13			782.36	47.7		
32	L							768.6	760.05	8.55	760.05	750.18	9.89	750.18	740.31	9.89			813.37	31.58		
33	L							767.3	767.04	0.27	767.04	762.81	4.23	762.81	758.58	4.23			799.69	41.89		
34	L							726.12	714.62	11.55	714.62	702.79	11.83	702.79	690.96	11.83			790.17	29.68		
35	L							682.1	666.26	15.85	666.26	648.91	17.35	648.91	631.56	17.35			801.29	48.34		
36	L							757.54	748.91	8.63	748.91	738.2	10.71	738.2	727.49	10.71			797.77	28.35		
37	L							736.54	723.5	13.04	723.5	709.1	14.4	709.1	694.7	14.4			806.15	40.18		
38	L							745.39	736.1	9.29	736.1	726.34	9.76	726.34	716.58	9.76			785.34	26.6		
39	L							819.35	802.42	16.93	802.42	785.72	16.7	785.72	769.02	16.7			818.28	46.26		
40	L							742.84	732.53	10.31	732.53	721.53	11	721.53	710.53	11			751.83	30.86		
Average Consumption								10.70			11.36			12.59					11.83			

Day		Monday			Tuesday			Wednesday			Thursday			Friday			Saturday		Sunday		Monday	
Date		5/27/2013			5/28/2013			5/29/2013			5/30/2013			5/31/2013			6/1/2013		6/2/2013		6/3/2013	
ID	Group	Food In	Food Out	Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend & Holiday		Food Out	Weekend Consumption		
41	M				766.03	755.2	10.83	755.2	742.05	13.15	742.05	727.11	14.94	727.11	712.17	14.94			738.88	43.29		
42	M				775.01	765.76	9.25	765.76	755.9	9.86	755.9	745.46	10.44	745.46	735.02	10.44			829.03	26.87		
43	M				713.25	700.86	12.39	700.86	687.01	13.85	687.01	673.52	13.49	673.52	660.03	13.49			766.44	39.23		
44	M				735	724.01	10.99	724.01	712.9	11.11	712.9	700.73	12.17	700.73	687.56	12.17			816.73	76.74		
45	M				780	778.4	11.6	778.4	714.51	13.89	714.51	701.37	13.14	701.37	687.23	13.14			761.37	72.11		
46	M				775.52	766.9	8.62	766.9	758.43	8.47	758.4	745.79	12.64	745.79	732.15	12.64			848.77	81.58		
47	M				713.82	699.49	14.33	699.49	685.01	14.88	685.0	669.92	15.08	669.92	654.84	15.08			761.08	69.87		
48	M				724.21	713.58	11.15	713.58	702.32	11.24	702.32	690.55	11.77	690.55	678.78	11.77			816.73	78.66		
49	M				791.8	780.06	11.74	780.06	764.68	15.38	764.68	751.34	13.34	751.34	738.05	13.34			809.57	783.93		
50	M				763.64	756.25	7.39	756.25	747.89	8.36	747.89	737.38	10.51	737.38	726.87	10.51			827.07	798.52		
51	M							739.77	715	14.77	715	699.85	15.15	699.85	684.70	15.15			772.82	728.88		
52	M							586.66	576.48	10.18	576.48	567.28	9.2	567.28	558.08	9.2			791	762.75		
53	M							744.4	731	13.4	731	718.23	12.77	718.23	705.46	12.77			784.7	744.83		
54	M							728	748.24	9.76	748.24	737.94	10.6	737.94	727.64	10.6			817.73	791		
55	M							690.52	675.13	15.41	675.1	658.54	16.57	658.54	643.97	16.57			834.19	763.27		
56	M							720.9	711.44	9.77	711.44	702.36	9.78	702.36	693.58	9.78			809.1	747.33		
57	M							638.54	643.88	14.66	643.88	628.38	15.5	628.38	613.88	15.5			792.54	763.27		
58	M							787.76	777.71	10.05	777.7	768.75	11.46	768.75	759.79	11.46			826.38	793.71		
59	M							783.9	770.41	13.18	770.4	756.68	13.73	756.68	743.95	13.73			857.68	809.4		
60	M							749.2	739.97	9.23	739.97	730.77	9.2	730.77	721.57	9.2			793.44	764.1		
Averages Consumption							10.829			12.01			12.58			12.58				36.07		

Food Consumption: Week 2

All Food weights include the weight of the feeder the food (in grams)																					
Day		Monday		Tuesday			Wednesday			Thursday			Friday			Saturday	Sunday	Monday			
Date		6/3/2013		6/4/2013			6/5/2013			6/6/2013			6/7/2013			6/8/2013		6/9/2013		6/10/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption			
1	C	786.66	769.9	16.76	769.9	749.62	20.28	749.62	735.2	14.42	735.2	720.38	14.82	715.22			673.31	41.91			
2	C	848.3	837.19	11.11	837.19	822.64	14.55	822.64	813.37	9.27	813.37	804.76	8.61	773.64			748.12	25.52			
3	C	794.39	774.75	19.64	774.75	756.08	18.67	756.08	742.86	13.22	742.86	729.91	12.95	814.16			770.68	43.48			
4	C	869.73	858.72	11.01	858.72	844.59	14.13	844.59	835.85	8.74	835.85	828.14	7.71	852.93			826.92	26.01			
5	C	809.74	792.64	17.1	792.64	774.05	18.59	774.05	761.12	12.93	761.12	749.39	11.73	847.03			805.79	41.24			
6	C	841.45	828.08	13.37	828.08	813.63	14.45	813.63	806.25	7.38	806.25	798.99	7.26	809.48			779.08	30.4			
7	C	795.83	778.24	17.59	778.24	760.63	17.61	760.63	746.32	14.31	746.32	734.65	11.67	791.15			751.41	39.74			
8	C	784.1	772.08	12.02	772.08	759.06	13.02	759.06	750.22	8.84	750.22	743.9	6.32	790.31			761.9	28.41			
109	C	828.72	812.18	16.54	812.18	795.7	16.48	795.7	780.79	14.91	780.79	769.17	11.62	877.78			838.72	39.06			
10	C	783.49	772.63	10.86	772.63	758	14.63	758	748.65	9.35	748.65	741.31	7.34	795.17			766.73	28.44			
11	C	818.11	803.45	14.66	803.45	784.31	19.14	784.31	770.1	14.21	770.1	758.92	11.18	859.43			820.25	39.18			
12	C	739.17	726.88	12.29	726.88	713.16	13.72	713.16	704.67	8.49	704.67	696.97	7.7	751.14			724.56	26.58			
13	C	778.15	761.24	16.91	761.24	741.13	20.11	741.13	726.37	14.76	726.37	712.46	13.91	803.5			760.79	42.71			
14	C	706.78	695.36	11.42	695.36	680.84	14.52	680.84	671.38	9.46	671.38	663.7	7.68	819.44			793.5	25.94			
15	C	799.4	784.19	15.21	784.19	766.1	18.09	766.1	753.46	12.64	753.46	743.17	10.29	818.35			779.76	38.59			
16	C	797.29	784.85	12.44	784.85	770.35	14.5	770.35	762.17	8.18	762.17	754.5	7.67	813.93			787.93	26			
117	C	792.49	774.99	17.5	774.99	754.38	20.61	754.38	739.84	14.54	739.84	727.26	12.58	804.29			758.76	45.53			
18	C	798.32	786.94	11.38	786.94	773.43	13.51	773.43	763.86	9.57	763.86	757.27	6.59	792.95			764.79	28.16			
19	C	808.13	791.78	16.35	791.78	772.33	19.45	772.33	758.65	13.68	758.65	747.11	11.54	810.95			768.6	42.35			
20	C	786.16	774.13	12.03	774.13	758.83	15.3	758.83	748.14	10.69	748.14	741.16	6.98	780.74			754.29	26.45			
Average Consumption					14.31			16.57			11.4795			9.8075					34.29		
Average Daily consumption 12.35																					
Day		Monday		Tuesday			Wednesday			Thursday			Friday			Saturday	Sunday	Monday			
Date		6/3/2013		6/4/2013			6/5/2013			6/6/2013			6/7/2013			6/8/2013		6/9/2013		6/10/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption			
21	L	803.43	789.99	13.44	789.99	771.19	18.8	771.19	757.92	13.27	757.92	745.61	12.31	803.51			761.74	41.77			
22	L	819.73	809.25	10.48	809.25	797.03	12.22	797.03	789.58	7.45	789.58	784.28	5.3	812.61			786.33	26.28			
23	L	769.02	754.62	14.4	754.62	736.99	17.63	736.99	722.2	14.79	722.2	710.1	12.1	808.73			766.37	42.36			
24	L	805.62	794.52	11.1	794.52	781.94	12.58	781.94	773.21	8.73	773.21	767.61	5.6	782.73			758.2	24.53			
25	L	772.48	758.23	14.25	758.23	740.85	17.38	740.85	730.69	10.16	730.69	720.17	10.52	814.81			777.36	37.45			
26	L	819.52	806.75	10.77	806.75	794.79	13.96	794.79	785.09	9.7	785.09	778.14	6.95	793.95			765.44	28.51			
27	L	776.69	761.36	15.33	761.36	741.24	20.12	741.24	725.36	15.88	725.36	709.23	16.13	750.25			699.07	51.18			
28	L	786.98	776.7	10.28	776.7	763.57	13.13	763.57	754.88	8.69	754.88	747.44	7.44	785.42			756.64	28.78			
129	L	822.11	807.47	14.64	807.47	787.57	19.9	787.57	773.18	14.39	773.18	759.81	13.37	794.09			749.44	44.65			
30	L	750.52	740.62	9.9	740.62	727.46	13.16	727.46	717.31	10.15	717.31	710.15	7.16	811.56			783.22	28.34			
31	L	782.36	766.02	16.34	766.02	746.14	19.88	746.14	732.68	13.46	732.68	719.45	13.23	820.01			773.21	46.8			
32	L	813.37	803.68	9.69	803.68	789.96	13.72	789.96	780.42	9.54	780.42	773.37	7.05	778.66			750.68	27.98			
33	L	799.69	782.55	17.14	782.55	760.51	22.04	760.51	744.18	16.33	744.18	730.18	14	774.59			722.24	52.35			
34	L	790.17	778.51	11.66	778.51	764.35	14.16	764.35	754.68	9.67	754.68	747.85	6.73	789.01			759.85	29.15			
35	L	801.29	784.53	16.76	784.53	765.48	19.05	765.48	749.62	15.86	749.62	734.5	15.12	797.41			749.42	47.99			
36	L	795.77	786.74	9.03	786.74	775.18	11.56	775.18	767.89	7.29	767.89	762.89	5	834.34			806.98	27.36			
37	L	806.18	791.6	14.58	791.6	772.92	18.68	772.92	758.52	14.4	758.52	748.63	9.89	818.75			776.82	41.93			
38	L	785.34	773.93	11.41	773.93	760.55	13.38	760.55	750.61	9.94	750.61	744.04	6.57	829.81			801.53	28.28			
39	L	818.28	802.15	16.13	802.15	781.13	21.02	781.13	764.95	16.18	764.95	749.82	15.13	797.94			754.33	43.61			
40	L	751.83	740.51	11.32	740.51	726.78	13.73	726.78	717.69	9.09	717.69	709.7	7.99	786.69			752.49				
Average Consumption					12.93			16.31			11.7485			9.8795					36.84		
Average Daily consumption 12.53																					
Day		Monday		Tuesday			Wednesday			Thursday			Friday			Saturday	Sunday	Monday			
Date		6/3/2013		6/4/2013			6/5/2013			6/6/2013			6/7/2013			6/8/2013		6/9/2013		6/10/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption			
41	M	738.98	723.23	15.75	723.23	706.51	16.72	706.51	693.4	13.11	693.4	679.92	13.48	792.93			750.12	42.81			
42	M	829.03	818.3	10.73	818.3	805.43	12.87	805.43	797.25	8.18	797.25	790.79	6.46	821.41			795.32	26.09			
43	M	706.44	693.38	13.06	693.38	678.53	14.85	678.53	666.71	11.82	666.71	655.95	10.76	789.47			750.94	38.53			
44	M	782.74	770.91	11.83	770.91	757.64	13.27	757.64	747.88	9.76	747.88	740.97	6.91	816.99			783.82	33.17			
45	M	721.51	707.83	13.68	707.83	691.85	15.98	691.85	678.16	13.69	678.16	667.23	10.93	777.6			734.37	43.23			
46	M	815.98	806.37	9.61	806.37	789.9	16.47	789.9	780.3	9.6	780.3	772.24	8.06	787.99			757.66	30.33			
47	M	698.17	684.65	13.52	684.65	667.71	16.94	667.71	654.11	13.6	654.11	641.48	12.63	774.14			730.09	44.05			
48	M	786.46	773.8	12.66	773.8	762.54	11.26	762.54	755.11	7.43	755.11	748.29	6.82	786.26			753.88	32.38			
49	M	765.93	750.75	15.18	750.75	733.53	17.22	733.53	718.51	15.02	718.51	707.74	10.77	824.21			780.74	43.47			
50	M	798.52	788.76	9.76	788.76	776.75	12.01	776.75	767.36	9.39	767.36	761.81	5.55	799.53			773.71	25.82			
51	M	728.88	713.32	15.56	713.32	695.16	18.16	695.16	681.6	13.56	681.6	669.07	12.53	812.83			768.09	44.74			
52	M	762.75	752.67	10.08	752.67	738.09	14.58	738.09	728.6	9.49	728.6	721.59	7.01	766.24			733.48	32.76			
53	M	744.85	730.66	14.19	730.66	713.79	16.87	713.79	700.44	13.35	700.44	689.61	10.83	828.17			787.45	40.72			
54	M	793	782.89	10.11	782.89	768.88	14.01	768.88	759.87	9.01	759.87	751.82	8.05	809.72			780.18	29.54			
55	M	786.86	771.78	15.08	771.78	753.51	18.27	753.51	737.74	15.77	737.74	724.95	12.79	783.69			735.89	47.8			
56	M	765.27	754.51	10.76	754.51	742.25	12.26	742.25	734.74	7.51	734.74	727.9	6.84	765.54			736.24	29.3			
57	M																				

Food Consumption: Week 3

All Food weights include the weight of the feeder the food (in grams)																									
Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday					
Date		6/10/2013				6/11/2013				6/12/2013				6/13/2013				6/14/2013				6/15/2013	6/16/2013	6/17/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption				
1	C	673.31	660.55	12.76	660.55	646.44	14.11	646.44	626.7	19.74	626.7	610.08	16.62	744.08						697.44	46.64				
2	C	748.12	740.26	7.86	740.26	731.06	9.2	731.06	717.77	13.29	717.77	704.27	13.5	804.71						769.13	35.58				
3	C	770.68	758.98	11.7	758.98	745.77	13.21	745.77	727.7	18.07	727.7	710.14	17.56	804.8						754.64	50.16				
4	C	826.92	819.2	7.72	819.2	810.68	8.52	810.68	797.68	13	797.68	785.52	12.16	881.02						844.95	36.07				
5	C	805.79	793.57	12.22	793.57	779.26	14.31	779.26	761.32	17.94	761.32	743.7	17.62	804.94						758.23	46.71				
6	C	779.08	771.54	7.54	771.54	761.77	9.77	761.77	748.25	13.52	748.25	733.06	15.19	811.67						775.26	36.41				
7	C	751.41	739.52	11.89	739.52	726.53	12.99	726.53	708.9	17.63	708.9	691.07	17.83	796.35						747.86	48.49				
8	C	761.9	754.73	7.17	754.73	746.83	7.9	746.83	733.86	12.97	733.86	720.63	13.23	812.65						777.78	34.87				
109	C	838.72	826.9	11.82	826.9	813.56	13.34	813.56	795.89	17.67	795.89	777.84	18.05	818.7						770.88	47.82				
10	C	766.73	757.98	8.75	757.98	749.79	8.19	749.79	734.65	15.14	734.65	721.47	13.18	823.04						785.78	37.26				
11	C	820.25	810.43	9.82	810.43	797.5	12.93	797.5	778.92	18.58	778.92	760.8	18.12	811.34						763.94	47.4				
12	C	724.56	717.95	6.61	717.95	711.09	6.86	711.09	696.46	14.63	696.46	683.06	13.4	869.48						833.3	36.18				
13	C	760.79	748.96	11.83	748.96	737.52	11.44	737.52	719.35	18.17	719.35	700.8	18.55	792.82						744.23	48.59				
14	C	793.5	784.83	8.67	784.83	776.25	8.58	776.25	761.82	14.43	761.82	745.84	15.98	819.05						784.88	34.17				
15	C	779.76	768.86	10.9	768.86	758.24	10.62	758.24	741.96	16.28	741.96	724.65	17.31	794.66						750.59	44.07				
16	C	787.93	780.8	7.13	780.8	771.61	9.19	771.61	757.81	13.8	757.81	743.06	14.75	802.53						765.48	37.05				
117	C	758.76	747.33	11.43	747.33	734.58	12.75	734.58	713.35	21.23	713.35	693.06	20.29	925.33						872.18	53.15				
18	C	764.79	756.94	7.85	756.94	750.24	6.7	750.24	735.89	14.35	735.89	720.61	15.28	787.42						751.58	35.84				
19	C	768.6	758.39	10.21	758.39	745.63	12.76	745.63	726.42	19.21	726.42	705.91	20.51	911.89						865.33	46.56				
20	C	754.29	747.69	6.6	747.69	740.59	7.1	740.59	728.15	12.44	728.15	712.95	15.2	995.41						961	34.41				
Average Consumption				9.52			10.52			16.10			16.22		Average Daily consumption			13.46			41.87				

Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday					
Date		6/10/2013				6/11/2013				6/12/2013				6/13/2013				6/14/2013				6/15/2013	6/16/2013	6/17/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption				
21	L	761.74	751.64	10.1	751.64	737.89	13.75	737.89	721.43	16.46	721.43	702.28	19.15	792.41						746.88	45.53				
22	L	786.33	781.13	5.2	781.13	773.05	8.08	773.05	761.41	11.64	761.41	748.4	13.01	807.34						776.37	30.97				
23	L	766.37	755.48	10.89	755.48	740.44	15.04	740.44	721.96	18.48	721.96	703	18.96	803.38						757.65	45.73				
24	L	758.2	751.76	6.44	751.76	741.18	10.58	741.18	727.81	13.37	727.81	709.79	18.02	804.21						768.88	35.33				
25	L	777.36	768.15	9.21	768.15	757.01	11.14	757.01	735.71	21.3	735.71	715.08	20.63	797.24						753.41	43.83				
26	L	765.44	760.66	4.78	760.66	752.05	8.61	752.05	738.92	13.13	738.92	724.09	14.83	780.19						745.22	34.97				
27	L	699.07	685.43	13.64	685.43	670.51	14.92	670.51	652.26	18.25	652.26	633.46	18.8	819.05						766.08	52.97				
28	L	756.64	750.77	5.87	750.77	741.03	9.74	741.03	729.72	11.31	729.72	715.39	14.33	798.16						763.45	34.71				
129	L	749.44	736.5	12.94	736.5	726.24	10.26	726.24	706.97	19.27	706.97	688.35	18.62	811.83						762.18	49.65				
30	L	783.22	776.31	6.91	776.31	767.22	9.09	767.22	753.07	14.15	753.07	737.74	15.33	798.56						760.11	38.45				
31	L	773.21	760.52	12.69	760.52	746.25	14.27	746.25	727.72	18.53	727.72	707.35	20.37	800.71						747.35	53.36				
32	L	750.68	744.25	6.43	744.25	734.34	9.91	734.34	722.07	12.27	722.07	708.2	13.87	806.45						770.23	36.22				
33	L	722.24	708.52	13.72	708.52	691.36	17.16	691.36	671.77	19.59	671.77	651.77	20	740.12						684.57	55.55				
34	L	759.85	752.44	7.41	752.44	743.64	8.8	743.64	728.55	15.09	728.55	713.87	14.68	800.2						763.56	36.64				
35	L	749.42	737.81	11.61	737.81	722.86	14.95	722.86	703.6	19.26	703.6	684.18	19.42	763.67						711.06	52.61				
36	L	806.98	802.34	4.64	802.34	794.09	8.25	794.09	781.12	12.97	781.12	768.01	13.11	809.54						775.17	34.37				
37	L	776.82	764.72	12.1	764.72	750.89	13.83	750.89	733.98	16.91	733.98	715.83	18.15	803.2						755.54	47.66				
38	L	801.53	794.91	6.62	794.91	784.16	10.75	784.16	770.77	13.39	770.77	756.62	14.15	798.54						764.08	34.46				
39	L	754.33	742.12	12.21	742.12	726.46	15.66	726.46	707.13	19.33	707.13	688.17	18.96	902.01						853.47	48.54				
40	L	752.49	745.53	6.96	745.53	736.82	8.71	736.82	721.49	15.33	721.49	706.87	14.62	909.3						867.38	41.92				
Average Consumption				9.0185			11.68			16.00			16.95		Average Daily consumption			13.76			42.67				

Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday					
Date		6/10/2013				6/11/2013				6/12/2013				6/13/2013				6/14/2013				6/15/2013	6/16/2013	6/17/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption				
41	M	750.12	737.78	12.34	737.78	727.1	10.68	727.1	706.6	20.94	706.6	690.43	15.73	771.47						725.5	45.97				
42	M	795.32	780.54	5.78	780.54	780.94	8.6	780.94	768.26	12.68	768.26	755.08	13.18	813.37						779.51	33.86				
43	M	750.94	740.53	10.41	740.53	729.15	11.38	729.15	713.3	15.85	713.3	697.83	15.47	915.55						748.6	42.95				
44	M	783.82	776.22	7.6	776.22	766.94	9.28	766.94	753.8	13.16	753.8	738.66	15.12	809.03						772.88	36.15				
45	M	743.37	733.62	10.75	733.62	711.29	12.33	711.29	695.13	16.16	695.13	678.05	17.08	788.68						742.4	46.28				
46	M	757.66	748.74	8.92	748.74	739.65	9.09	739.65	724.58	15.07	724.58	709.39	15.19	819.46						775.82	42.64				
47	M	780.09	771.11	12.98	771.11	764.58	12.43	764.58	750.78	16.59	750.78	736.62	18.16	891.54						741.71	48.39				
48	M	753.88	743.79	10.0	743.79	733.72	10.07	733.72	719.6	14.36	719.36	704.59	14.77	801.34						762.67	38.67				
49	M	780.74	768.32	12.42	768.32	755.21	13.11	755.21	738.8	16.43	738.78	722.77	16.01	824.91						778.23	45.68				
50	M	773.71	766.44	7.27	766.44	758.47	7.97	758.47	747.81	11.06	747.81	734.19	13.22	821.11						787.45	33.66				
51	M	768.09	756.64	11.45	756.64	744.9	11.74	744.9	727.5	17.15	727.5	709.87	17.88	94.98						784.54	50.14				
52	M	733.48	726.15	7.33	726.15	717.32	8.83	717.32	703.85	13.47	703.85	691.15	12.7	92.25						757.1	35.15				
53	M	747.65	736.98	10.67	736.98	724.57	12.41	724.57	710.81	15.86	710.81	703.01	15.7	811.37						764.58	46.79				
54	M	780.18	772.4	7.78	772.4	764	8.4	764	752.85	11.15	752.85	739.92	12.93	812.34						778.44	33.9				
55	M	735.89	720.97	14.92	720.97	707.07	13.9	707.07	690.04	17.03	690.04	673.37	16.67	98.96											

Food Consumption: Week 4

All Food weights include the weight of the feeder the food (in grams)																					
Day		Monday	Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		6/17/2013	6/18/2013				6/19/2013				6/20/2013				6/21/2013				6/22/2013	6/23/2013	6/24/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed		
1	C	697.44	683.26	14.18	683.26	668.24	15.02	668.24	651.56	16.68	651.56	637.49	14.07	819.25					775.59	43.66	
2	C	769.13	758.13	11	758.13	746.71	11.42	746.71	733.98	12.73	733.98	723.14	10.84	808.97					780.74	28.23	
3	C	754.64	740.12	14.52	740.12	724.17	15.95	724.17	707.01	17.16	707.01	691.92	15.09	815.87					768.69	47.18	
4	C	844.95	834.07	10.88	834.07	822.19	11.88	822.19	809.09	13.1	809.09	799.21	9.88	949.25					918.71	30.54	
5	C	758.23	742.51	15.72	742.51	726.55	15.96	726.55	711.11	15.44	711.11	696.36	14.75	815.14					771.23	43.91	
6	C	775.26	763.42	11.84	763.42	750.92	12.5	750.92	737.67	13.25	737.67	726.18	11.49	828.09					796.6	31.49	
7	C	747.86	733.24	14.62	733.24	717.02	16.22	717.02	700.66	16.36	700.66	686.79	13.87	957.28					913.41	43.87	
8	C	777.78	767.8	9.98	767.8	758.21	9.59	758.21	746.02	12.19	746.02	736.41	9.61	811.96					780.97	30.99	
109	C	770.88	755.62	15.26	755.62	740.52	15.1	740.52	722.8	18.34	722.8	707.78	14.4	806.09					762	44.09	
10	C	785.78	775.01	10.77	775.01	763.49	11.52	763.49	750.52	12.97	750.52	740.48	10.04	829.17					796.84	32.33	
11	C	763.94	749.45	14.49	749.45	734.3	15.15	734.3	717.99	16.31	717.99	704.54	13.45	823.05					782.99	40.06	
12	C	833.3	823.45	9.85	823.45	813.49	9.96	813.49	799.79	13.7	799.79	791.33	8.46	838.36					809.2	29.16	
13	C	744.23	728.65	15.58	728.65	712.63	16.02	712.63	695.6	17.03	695.6	680.41	15.19	798.03					753.0	44.13	
14	C	784.88	773.48	11.4	773.48	762.73	10.75	762.73	748.73	14	748.73	738.02	10.71	900.31					869.74	30.57	
15	C	750.59	735.79	14.8	735.79	721.15	14.64	721.15	704.92	16.23	704.92	691.52	13.4	812.38					771.15	41.23	
16	C	765.48	753.25	12.23	753.25	742.5	10.75	742.5	729.03	13.47	729.03	719.37	9.66	819.5					789.48	30.02	
117	C	872.18	854.9	17.28	854.9	837.36	17.54	837.36	819.19	18.17	819.19	802.33	16.86	820.66					771.68	48.98	
18	C	751.58	739.75	11.83	739.75	728.13	11.62	728.13	715.19	12.94	715.19	704.71	10.48	823.38					793.75	29.63	
19	C	865.33	849.59	15.74	849.59	832.83	16.76	832.83	814.77	18.06	814.77	799.16	15.61	933.88					890.63	43.25	
20	C	961	948.3	12.7	948.3	935.81	12.49	935.81	920.9	14.91	920.9	910.02	10.88	933.8					902.46	31.34	
Average Consumption				13.23				13.54			15.15		12.44				Average Daily consumption		13.09	37.23	

Day		Monday	Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		6/17/2013	6/18/2013				6/19/2013				6/20/2013				6/21/2013				6/22/2013	6/23/2013	6/24/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed		
21	L	746.88	732.39	14.49	732.39	715.74	16.65	715.74	698.48	17.26	698.48	684.18	14.3	821.06					771.14	43.92	
22	L	776.37	766.09	10.28	766.09	756.6	9.49	756.6	745.5	11.1	745.5	736.55	8.95	838.3					812.27	26.03	
23	L	757.65	742.6	15.05	742.6	727.93	14.67	727.93	711.03	16.9	711.03	695.73	15.3	828.15					785.25	42.9	
24	L	768.88	760.67	8.21	760.67	750.4	10.27	750.4	738.12	12.28	738.12	728.43	9.69	827.55					800.11	27.44	
25	L	753.41	739.67	13.74	739.67	726.69	12.98	726.69	710.94	15.75	710.94	697.57	13.37	810.09					771.85	38.24	
26	L	745.22	735.25	9.97	735.25	724.34	10.91	724.34	711.77	12.57	711.77	703.68	8.09	819.94					789.27	30.67	
27	L	766.08	749.56	16.52	749.56	732.13	17.43	732.13	711.53	20.6	711.53	694.12	17.41	829.39					780.02	49.37	
28	L	763.45	755.26	8.19	755.26	743.93	11.33	743.93	730.22	13.71	730.22	719.73	10.49	828.73					796.26	32.47	
129	L	762.18	747.27	14.91	747.27	730.48	16.79	730.48	713.55	16.93	713.55	699.41	14.14	821.2					773.88	47.32	
30	L	760.11	749.92	10.19	749.92	738.55	11.37	738.55	723.29	15.26	723.29	712.73	10.56	811					779.43	31.57	
31	L	747.35	732.06	15.29	732.06	713.91	18.15	713.91	695.2	18.71	695.2	679.3	15.9	806.61					758.27	48.34	
32	L	770.23	760.01	10.22	760.01	748.03	11.98	748.03	734.33	13.7	734.33	723.61	10.72	817.21					788.22	28.99	
33	L	684.57	667.63	16.94	667.63	651.4	16.23	651.4	630.64	20.76	630.64	613.74	16.9	819.05					765.42	53.63	
34	L	763.56	753.26	10.3	753.26	742.28	10.98	742.28	728.71	13.57	728.71	719.04	9.67	837.25					804.45	32.8	
35	L	711.06	695.62	15.44	695.62	679.07	16.55	679.07	659.59	19.48	659.59	643.92	15.67	814.3					764.04	50.26	
36	L	775.17	764.38	10.79	764.38	754.32	10.06	754.32	741.43	12.89	741.43	732.61	8.82	831.04					803.64	27.4	
37	L	755.54	740.26	15.28	740.26	723.33	16.93	723.33	704.74	18.59	704.74	691.11	13.63	816.3					771.44	44.86	
38	L	764.08	754.85	9.23	754.85	743.41	11.44	743.41	730.59	12.82	730.59	720.65	9.94	804.21					776.88	27.33	
39	L	853.47	837.23	16.24	837.23	819.49	17.74	819.49	799.18	20.31	799.18	782.36	16.82	831.12					785.07	46.05	
40	L	867.38	855.06	12.32	855.06	842.43	12.63	842.43	826.12	16.31	826.12	815.95	10.17	815.97					781.48	34.49	
Average Consumption				12.68				13.73			15.98		12.53				Average Daily consumption		13.30	38.20	

Day		Monday	Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		6/17/2013	6/18/2013				6/19/2013				6/20/2013				6/21/2013				6/22/2013	6/23/2013	6/24/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed		
41	M	725.5	711.6	13.9	711.6	697.09	14.51	697.09	680.05	17.04	680.05	667.22	12.83	801.75					761.63	40.12	
42	M	779.51	769.96	9.55	769.96	758.73	11.23	758.73	746.18	12.55	746.18	736.49	9.69	837.53					810.15	27.38	
43	M	748.6	734.85	13.75	734.85	720.5	14.35	720.5	706.24	14.26	706.24	693.58	12.66	813.21					774.99	38.22	
44	M	772.88	761.42	11.46	761.42	750.46	10.96	750.46	739.06	11.4	739.06	727.03	12.03	812.6					780.02	32.58	
45	M	742.4	728.94	13.46	728.94	712.41	16.53	712.41	695	17.41	695	680.05	14.95	811.31					768.85	42.46	
46	M	776.82	764.71	12.11	764.71	751.82	12.89	751.82	735.5	16.32	735.5	723.65	11.85	823.4					789.85	33.55	
47	M	761.75	745.86	15.89	745.86	731.3	15.56	731.3	692.62	18.68	692.62	679.98	12.64	811.39					765.54	45.86	
48	M	762.87	750.42	12.25	750.42	737.35	13.17	737.35	723	14.25	723	710.99	12.01	806.64					773.24	33.4	
49	M	778.23	762.52	15.71	762.52	747.23	15.29	747.23	731.06	16.17	731.06	717.1	13.96	800.58					754.77	45.81	
50	M	787.45	776.65	10.8	776.65	767.66	8.99	767.66	755.68	11.98	755.68	745.63	10.05	808.22					778.41	29.81	
51	M	744.84	730.54	14.3	730.54	713.94	16.6	713.94	695.05	18.29	695.05	681.54	14.11	810.22					768.26	41.96	
52	M	757.1	746.75	10.35	746.75	736.33	10.42	736.33	722.85	13.48	722.85	712.56	10.29	801.37					770.18	31.19	
53	M	763.58	750.69	13.89	750.69	734.91	15.78	734.91	718.32	16.59	718.32	704.16	14.16	815					773.44	41.56	
54	M	778.44	769.22																		

Food Consumption: Week 5

Food weights include the weight of the feeder the food (in grams)																								
Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday				
Date		6/24/2013				6/25/2013				6/26/2013				6/27/2013				6/28/2013				6/29/2013	6/30/2013	7/1/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption			
1	C	775.59	761.59	14	761.59	745.7	15.89	745.7	731.11	14.59	731.11	714.5	16.61	714.5	708.56	5.95	820.95			770.85	47.71			
2	C	780.74	771.27	9.47	771.27	759.56	11.71	759.56	748.19	11.37	748.19	738.64	9.55	738.64	730.98	7.66	820.95			788.06	32.89			
3	C	768.69	752.34	16.35	752.34	736.67	15.67	736.67	719.13	17.54	719.13	703.98	15.15	703.98	696.44	7.54	820.95			870.1	48.68			
4	C	918.71	910.21	8.5	910.21	899.77	10.44	899.77	891.65	8.12	891.65	882.05	9.6	882.08	874.51	7.57	820.95			851.41	30.67			
5	C	771.23	757.25	13.98	757.25	741.57	15.68	741.57	726	15.57	726	712.36	13.64	712.36	704.82	7.54	820.95			866.16	48.43			
6	C	796.6	786.02	10.58	786.02	774.18	11.84	774.18	763.7	10.48	763.7	752.12	11.58	752.12	744.58	7.54	820.95			861.42	31.78			
7	C	913.41	900.16	13.25	900.16	884.06	16.1	884.06	869.27	14.79	869.27	852.41	16.86	852.41	844.87	7.54	820.95			802.88	49.55			
8	C	780.97	772.08	8.89	772.08	761.57	10.51	761.57	750.64	10.93	750.64	741.24	9.4	741.24	732.7	8.54	820.95			774.34	32.34			
109	C	762	749.15	12.85	749.15	733.49	15.66	733.49	717.94	15.55	717.94	703.51	14.43	703.51	696.07	7.44	820.95			762.16	48.39			
10	C	796.84	788.06	8.78	788.06	778.31	9.75	778.31	768.15	10.16	768.15	759.04	9.11	759.04	750.93	8.11	820.95			773.26	31.65			
11	C	782.99	770.16	12.83	770.16	754.61	15.55	754.61	740.43	14.18	740.43	726.47	13.96	726.47	718.51	7.96	820.95			869.81	47.27			
12	C	809.2	800.01	9.19	800.01	790.2	9.81	790.2	778.85	11.35	778.85	771.1	7.75	771.1	763.35	7.75	820.95			786.42	31.9			
13	C	753.9	738.23	15.67	738.23	723.74	14.49	723.74	709.79	13.95	709.79	694.4	15.39	694.4	686.9	7.5	820.95			769.27	49.57			
14	C	869.74	860.63	9.11	860.63	848.79	11.84	848.79	835.86	12.93	835.86	828.48	7.38	828.5	821.1	7.38	820.95			793.78	34.72			
15	C	771.15	756.59	14.56	756.59	741.26	15.33	741.26	728.2	13.06	728.2	713.81	14.39	713.81	706.42	7.39	820.95			763.74	45.86			
16	C	789.48	779.99	9.49	779.99	768.42	11.57	768.42	756.32	12.1	756.32	746.86	9.46	746.86	739.4	7.46	820.95			800.07	32.22			
117	C	771.68	755.25	16.43	755.25	740.6	14.65	740.6	724.52	16.08	724.52	708.48	16.04	708.48	701.43	7.05	820.95			767.4	52.51			
18	C	793.75	782.67	11.08	782.67	770.89	11.78	770.89	760.91	9.98	760.91	751	9.91	751	743.09	7.91	820.95			881.91	33.74			
19	C	890.63	875.88	14.75	875.88	860.39	15.49	860.39	844.89	15.5	844.89	830.25	14.64	830.25	822.61	7.64	820.95			838.86	45			
20	C	902.46	893.64	8.82	893.64	882.72	10.92	882.72	872.92	9.8	872.92	862.5	10.42	862.5	854.08	8.42	820.95			899.47	30.66			
Average Consumption		11.93				13.23				12.90				12.26				Average Daily consumption		12.94		40.28		

Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday		
Date		6/24/2013				6/25/2013				6/26/2013				6/27/2013				6/28/2013	6/29/2013	6/30/2013	7/1/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption	
21	L	777.14	761.41	15.73	761.41	744.67	16.74	744.67	730.39	14.28	730.39	716.71	13.68	716.71	709.03	7.68	816.86			769.46	47.4	
22	L	812.27	804.29	7.98	804.29	794.33	9.96	794.33	785.01	9.32	785.01	776.38	8.63	776.38	767.75	8.63	840.68			811.14	29.54	
23	L	785.25	770.97	14.28	770.97	755.25	15.72	755.25	739.58	15.67	739.58	725.35	14.23	725.35	717.12	8.23	826.45			780.2	46.25	
24	L	800.11	791.05	9.06	791.05	779.25	11.8	779.25	768.01	11.24	768.01	760.26	7.75	760.26	752.51	7.75	840.45			806.86	33.59	
25	L	771.85	758.24	13.61	758.24	742.56	15.68	742.56	727.34	15.22	727.34	712.79	14.55	712.79	705.24	7.55	824.17			778.21	45.96	
26	L	789.27	780.41	8.86	780.41	771.16	9.25	771.16	758.14	13.02	758.14	747.33	10.81	747.33	740.52	6.81	812.71			779.47	33.24	
27	L	780.02	764.44	15.58	764.44	748.1	16.34	748.1	730.53	17.57	730.53	712.37	18.16	712.37	704.21	8.16	839			764.24	54.15	
28	L	796.26	786.38	9.88	786.38	776.92	9.46	776.92	767.36	9.56	767.36	758.16	9.2	758.16	750.96	7.2	821.48			787.76	33.72	
129	L	773.88	760.01	13.87	760.01	743.32	16.69	743.32	728.14	15.18	728.14	713.7	14.44	713.7	706.26	7.44	822.71			772.87	49.84	
30	L	779.43	771.13	8.3	771.13	759.21	11.92	759.21	748.81	10.4	748.81	737.69	11.12	737.69	730.57	7.12	829.71			792.53	37.18	
31	L	758.27	744.41	13.86	744.41	727.11	17.3	727.11	709.92	17.19	709.92	694.17	15.75	694.17	686.42	7.75	833.2			781.86	51.34	
32	L	788.22	780.22	8	780.22	768.48	11.74	768.48	757.63	10.85	757.63	747.94	9.69	747.94	740.25	7.69	815.86			784.11	31.75	
33	L	765.42	747.7	17.72	747.7	728.44	19.26	728.44	713.13	15.31	713.13	694.1	19.03	694.1	686.4	7.7	835.6			778.4	57.2	
34	L	804.45	793.54	10.91	793.54	782.28	11.26	782.28	770.64	11.64	770.64	759.22	11.42	759.22	751.8	7.42	827			779.95	36.32	
35	L	764.04	748.2	15.84	748.2	731.07	17.13	731.07	714.47	16.6	714.47	698.13	16.34	698.13	690.79	7.34	809.33			756.28	53.05	
36	L	803.64	793.69	9.95	793.69	783.39	10.3	783.39	774.05	9.34	774.05	764.53	9.52	764.53	756.01	8.52	813.92			782.27	31.65	
37	L	771.44	756.32	15.12	756.32	741.09	15.23	741.09	724.78	16.31	724.78	709.48	15.3	709.48	702.18	7.3	816.5			768.59	47.91	
38	L	776.88	767.12	9.76	767.12	754.6	12.52	754.6	742.78	11.82	742.78	733.78	9	733.78	726.08	7.7	817.23			784.86	32.37	
39	L	785.07	768.49	16.58	768.49	750.71	17.78	750.71	733.89	16.82	733.89	716.37	17.52	716.37	708.85	7.52	827.25			776.45	50.8	
40	L	781.48	770.41	11.07	770.41	757.78	12.63	757.78	746.81	10.97	746.81	734.79	12.02	734.79	727.27	7.52	820.54			785.73	34.81	
Average Consumption		12.30				13.94				13.42				12.91				Average Daily consumption		13.49		41.90

Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		6/24/2013				6/25/2013				6/26/2013				6/27/2013				6/28/2013	6/29/2013	6/30/2013	7/1/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption
41	M	761.63	749.13	12.5	749.13	735.76	13.37	735.76	721.39	14.37	721.39	708.7	12.69	708.7	701.01	7.69	813.99			772.2	41.79
42	M	810.15	799.85	10.3	799.85	788.45	11.4	788.45	778.18	10.27	778.18	767.87	10.31	767.87	759.56	8.31	820.74			785.68	35.06
43	M	774.99	760.64	14.35	760.64	747.67	12.97	747.67	734.64	13.03	734.64	720.21	14.43	720.21	712.43	7.78	827.71			785.97	31.78
44	M	780.92	768.87	12.05	768.87	757.91	10.96	757.91	746.86	11.05	746.86	735.03	11.83	735.03	727.18	7.85	818			792.92	37.24
45	M	764.36	754.23	10.13	754.23	743.09	11.14	743.09	732.74	11.15	732.74	720.71	12.03	720.71	712.87	7.84	837.46			797.86	47.36
46	M	789.85	777.89	11.96	777.89	765.53	12.36	765.53	753.3	11.73	753.3	741.18	12.62	741.18	733.96	7.22	817.96			779.66	38.3
47	M	765.54	752.0	13.54	752.0	740.75	11.29	740.75	729.12	14.64	729.12	716.43	12.69	716.43	708.74	7.69	813.99			779.66	47.36
48	M	773.24	761.2	12.04	761.2	750.02	11.22	750.02	738.08	11.94	738.08	725.71	12.37	725.71	717.92	7.79	820.58			779.68	40.3
49	M	754.77	741.48	13.29	741.48	724.58	16.9	724.58	709.84	14.74	709.84	694.75	15.09	694.75	687.12	7.63	815.86			785.61	48.51
50	M	768.41	768.42	9.99	768.																

Food Consumption: Week 6

All Food weights include the weight of the feeder the food (in grams)																					
Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		7/2/2013				7/3/2013				7/4/2013				7/5/2013				7/6/2013	7/7/2013	7/8/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption	
1	C	770.85	753.96	16.89	753.96	737.2	16.76	737.2			0			704.24	32.96	824.43			772.86	51.57	
2	C	788.06	777.17	10.89	777.17	766.57	10.6	766.57						743.86	22.71	805.01			770.01	35	
3	C	870.1	854.76	15.34	854.76	837.98	16.78	837.98						804.6	33.38	845.84			794.63	51.21	
4	C	851.41	842.46	8.95	842.46	831.73	10.73	831.73						809.85	21.88	842.24			809.59	32.65	
5	C	866.16	850.82	15.34	850.82	834.29	16.53	834.29						802.82	31.47	834.23			782.94	51.29	
6	C	861.42	850.64	10.78	850.64	839.37	11.27	839.37						818.62	20.75	910.74			876.94	33.8	
7	C	802.88	787.19	15.69	787.19	769.99	17.2	769.99						737.29	32.7	854.38			804.2	50.18	
8	C	774.34	765.45	8.89	765.45	754.17	11.28	754.17						733.16	21.01	838.2			805.59	32.61	
109	C	762.16	746.78	15.38	746.78	730.09	16.69	730.09						697.72	32.37	753.74			702.81	50.93	
10	C	773.26	763.49	9.77	763.49	751.66	11.83	751.66						729.39	22.27	802.57			767.19	35.38	
11	C	869.81	855.08	14.73	855.08	839.52	15.56	839.52						809.19	30.33	913.86			867.75	46.11	
12	C	786.42	776.75	9.67	776.75	765.19	11.56	765.19						743.99	21.2	800.25			769.36	30.89	
13	C	769.7	753.89	15.81	753.89	738.15	15.74	738.15						702.77	35.38	836.41			783.05	53.36	
14	C	793.78	784.12	9.66	784.12	772.68	11.44	772.68						748.44	24.24	862.11			829.69	32.42	
15	C	763.74	750.03	13.71	750.03	734.19	15.84	734.19						702.61	31.58	770.39			723.83	46.56	
16	C	800.07	790.32	9.75	790.32	779.2	11.12	779.2						759.69	19.51	846.15			814.93	31.22	
117	C	767.4	751.17	16.23	751.17	735.15	16.02	735.15						702.57	32.58	885.97			831.64	54.33	
18	C	881.91	873.04	8.87	873.04	861.48	11.56	861.48						839	22.48	862.98			829.77	33.21	
19	C	838.86	823.75	15.11	823.75	808.83	14.92	808.83						778.21	30.62	936.9			888.74	48.16	
20	C	899.47	889.94	9.53	889.94	879.5	10.44	879.5						856.14	23.36	986.15			948.45	37.7	
Average Consumption				12.55			13.69				0	Placeholder			27.14			Average Daily consumption		13.62	41.93
Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		7/2/2013				7/3/2013				7/4/2013				7/5/2013				7/6/2013	7/7/2013	7/8/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption	
21	L	769.46	754.43	15.03	754.43	739.19	15.24	739.19			0			708.62	30.57	839.57			790.92	48.65	
22	L	811.14	801.68	9.46	801.68	790.62	11.06	790.62						770.51	20.11	860.62			829.73	30.89	
23	L	780.2	767.18	13.02	767.18	750.59	16.59	750.59						717.1	33.49	771.44			720.94	50.5	
24	L	806.86	799.15	7.71	799.15	788.93	10.22	788.93						766.72	22.21	867.59			838.8	28.79	
25	L	778.21	763.67	14.54	763.67	747.5	16.17	747.5						715.3	32.2	805.14			757.34	47.8	
26	L	779.47	768.51	10.96	768.51	758.51	10	758.51						735.84	22.67	805.9			778.63	31.96	
27	L	764.24	749.29	14.95	749.29	731.94	17.35	731.94						695.64	36.3	820.41			766.86	53.55	
28	L	787.76	777.33	10.43	777.33	765.79	11.54	765.79						741.41	24.38	885.05			851.83	33.22	
129	L	772.87	757.62	15.25	757.62	739.15	18.47	739.15						706.19	32.96	811.39			759.38	52.01	
30	L	792.53	782.22	10.31	782.22	769.63	12.59	769.63						741.47	28.16	952.44			918.96	33.48	
31	L	781.86	764.55	17.31	764.55	748.11	16.44	748.11						712.52	35.59	854.18			802.58	51.6	
32	L	784.11	773.39	10.72	773.39	762.49	10.9	762.49						739.51	22.98	883.87			851.33	32.54	
33	L	778.4	760.67	17.73	760.67	740.89	19.78	740.89						703.42	37.47	793.2			736.37	56.83	
34	L	779.95	769.2	10.75	769.2	757.53	11.67	757.53						733.34	24.19	918.4			885.79	32.61	
35	L	756.28	738.39	17.89	738.39	720.57	17.82	720.57						684.43	36.14	766.81			711.06	55.75	
36	L	782.27	773.62	8.65	773.62	762.54	11.08	762.54						741.43	21.11	806.96			806.25	30.71	
37	L	768.59	750.56	18.03	750.56	734.54	16.02	734.54						701.4	33.14	804.61			759.11	45.5	
38	L	784.86	774.14	10.72	774.14	765.08	9.06	765.08						742.66	22.42	894.82			867.01	27.81	
39	L	776.45	759.2	17.25	759.2	741.27	17.93	741.27						708.32	32.95	843.11			797.9	45.21	
40	L	785.73	775.4	10.33	775.4	762.64	12.76	762.64						738.47	24.17	871.49			833.81	37.68	
Average Consumption				13.05			14.13				0	Placeholder			28.66			Average Daily consumption		13.89	41.35
Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		7/2/2013				7/3/2013				7/4/2013				7/5/2013				7/6/2013	7/7/2013	7/8/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption	
41	M	772.2	758	14.2	758	743.99	14.01	743.99			0			715.33	28.66	843.79			800.81	42.98	
42	M	785.68	776.33	9.35	776.33	764.56	11.77	764.56						740.57	23.99	809.91			845.45	34.46	
43	M	785.97	773.43	12.54	773.43	759.72	13.71	759.72						731.24	28.48	903.29			861.53	41.76	
44	M	792.92	782.67	10.25	782.67	772.36	10.31	772.36						748.45	23.91	849.66			816.51	33.15	
45	M	790.09	775.91	14.18	775.91	759.85	16.06	759.85						728.18	31.67	895.46			848.16	47.3	
46	M	779.56	770.59	9.07	770.59	757	13.59	757						729.63	27.37	880.12			847.27	32.85	
47	M	779.83	766	13.83	766	748.76	16.24	748.76						717.05	32.71	835.91			788.31	46.91	
48	M	779.68	770.07	9.61	770.07	757.92	12.35	757.92						730.53	27.19	885.5			852.04	33.46	
49	M	785.61	770.6	15.01	770.6	754.3	16.3	754.3						723.48	30.82	821.76			775.63	46.13	
50	M	778.39	768.67	9.72	768.67	757.8	10.87	757.8						736	21.8	885.66			856.84	28.82	
51	M	763.84	747.92	15.92	747.92	732.28	15.64	732.28						700.77	31.51	825.39			779.36	46.03	
52	M	773.91	764.94	8.97	764.94	753.01	11.93	753.01						730.57	22.44	890.67			859.93	30.74	
53	M	775.63	761.59	14.04	761.59	746.9	14.69	746.9						717.05	29.85	829.97			786.52	43.45	
54	M	802.61	792.8	9.81	792.8	783.04	9.76	783.04						762.99	20.05	928.46			899.85	28.61	
55	M	760.74	745.28	15.46	745.28	727.83	17.45	727.83						692.94	34.89	813.66			760.84	52.82	
56	M	803.67	792.38	11.29	792.38	781.53	10.85	781.53						759.78	21.75	913.93			880.46	33.47	
57	M	769.22	754.71	14.51	754.71	739.68	15.03	739.68						708.62	31.06	805.73			761.07	44.66	
58	M	772.92	763.28	9.64	763.28	752.56	10.72	752.56						729.6	22.96	837.68			804.74	32.94	
59	M	774.31	757.77	16.54	757.77	740.95	16.82	740.95						703.73	37.22	806.95			756.54	50.28	
60	M	797.91	788.4	9.51	788.4	777.16	11.24	777.16						755.1	22.06	836.9			802.02	39.29	

Food Consumption: Week 7

Food weights include the weight of the feeder the food (in grams)																									
Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday			
Date		7/8/2013		7/9/2013				7/10/2013				7/11/2013				7/12/2013				7/13/2013	7/14/2013	7/15/2013			
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption					
1	C	772.86	758.95	13.91	758.95	741.65	17.3	741.65	724.93	16.72	724.93	708.97	15.96	708.97	787.04			Weekend	737.96	49.08					
2	C	770.01	758.93	11.08	758.93	744.74	14.19	744.74	735.46	9.28	735.46	722.66	12.8	730.28					698.75	31.53					
3	C	794.63	779.25	15.38	779.25	761.46	17.79	761.46	747.15	14.31	747.15	730.46	16.69	800.4					750.62	49.78					
4	C	809.59	799.15	10.44	799.15	788.71	10.44	788.71	778.41	10.3	778.41	767.03	11.38	776.83					744.66	32.17					
5	C	782.94	767.23	15.71	767.23	751.65	15.58	751.65	735.48	16.17	735.48	718.66	16.82	813.61					764.58	49.03					
6	C	876.94	865.9	11.04	865.9	855.14	10.76	855.14	844.6	10.78	844.36	832.46	11.9	845.22					810.62	34.6					
7	C	804.2	788.84	15.36	788.84	771.39	17.45	771.39	754.89	16.5	754.89	737.44	17.45	806.84					757.05	49.79					
8	C	805.59	795.29	10.3	795.29	784.84	10.45	784.84	774.07	10.77	774.07	763.29	10.78	772.7					739.75	32.95					
109	C	702.81	687.14	15.67	687.14	669.77	17.37	669.77	658.66	11.11	658.66	644.18	14.48	775.56					728.19	47.37					
10	C	767.19	757.01	10.18	757.01	746.41	10.6	746.41	735.67	10.74	735.67	722.91	12.76	726.68					693.78	32.9					
11	C	867.75	851.42	16.33	851.42	835.93	15.49	835.93	820.27	15.66	820.27	802.49	17.78	810.5					764.37	46.13					
12	C	769.36	758.08	11.28	758.08	748.07	10.01	748.07	737.36	10.71	737.36	726.13	11.23	7	8.11				708.32	29.79					
13	C	783.05	767.53	15.52	767.53	751.74	15.79	751.74	735.48	16.26	735.48	719.57	15.91	809.21					752.59	50.62					
14	C	829.69	819.14	10.55	819.14	807	12.14	807	795.16	11.84	795.16	784.45	10.71	789.17					756.09	33.08					
15	C	723.83	707.6	16.23	707.6	691.45	16.15	691.45	676.32	15.13	676.32	661.49	14.83	835.24					787.9	47.34					
16	C	814.93	801.6	13.33	801.6	793.39	8.21	793.39	781.36	12.03	781.36	767.29	14.07	776.25					747.54	28.71					
117	C	831.64	814.97	16.67	814.97	797.64	17.33	797.64	778.5	19.14	778.5	762.98	15.52	787.7					737.89	49.81					
18	C	829.77	819.89	9.88	819.89	807.62	12.27	807.62	795.85	11.77	795.85	785.83	10.02	843.55					812.75	30.8					
19	C	888.74	870.88	17.86	870.88	855.96	14.92	855.96	839.84	16.12	839.84	821.92	17.92	960.04					915.01	45.03					
20	C	948.45	936.82	11.63	936.82	925.94	10.88	925.94	914.08	11.86	914.08	901.03	13.05	923.29					891.98	31.31					
Average Consumption				13.42				13.76				13.36				14.10				Average Daily consumption				13.53	40.09

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday			
Date		7/8/2013		7/9/2013				7/10/2013				7/11/2013				7/12/2013				7/13/2013	7/14/2013	7/15/2013			
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption					
21	L	790.92	775.32	15.6	775.32	760.02	15.3	760.02	745.36	14.66	745.36	728.36	17	849.51					800.66	48.85					
22	L	829.73	819.78	9.95	819.78	810.19	9.59	810.19	800.38	9.81	800.38	788.45	11.93	823.13					795.39	27.74					
23	L	720.94	707.2	13.74	707.2	667.86	39.34	667.86	674.02	-6.16	674.02	656.6	17.42	864.27					818.9	45.37					
24	L	838.8	826.96	11.84	826.96	816.79	10.17	816.79	805.71	11.08	805.71	794.33	11.38	851.75					824.66	27.09					
25	L	757.34	741.92	15.42	741.92	725.51	16.41	725.51	710.45	15.06	710.45	693.11	17.34	904.04					856.6	47.44					
26	L	778.63	768.09	10.54	768.09	755.42	12.67	755.42	744.33	11.09	744.33	729.18	15.15	856.26					825.22	31.04					
27	L	766.86	747.36	19.5	747.36	728.74	18.62	728.74	710.7	18.04	710.7	689.15	21.55	893.06					835.41	57.65					
28	L	851.83	842.34	9.49	842.34	830.03	12.31	830.03	817.6	12.43	817.6	805.43	12.17	835.88					801.49	34.39					
129	L	759.38	742.05	17.33	742.05	725.37	16.68	725.37	708.27	17.1	708.27	688.3	19.97	849.49					799.58	49.91					
30	L	918.96	906.46	12.5	906.46	894.07	12.39	894.07	882.18	11.89	882.18	868.06	14.12	877.22					841.55	35.67					
31	L	802.58	785.85	16.73	785.85	768.6	17.25	768.6	750.23	18.37	750.23	732.11	18.12	892.93					843.37	49.56					
32	L	851.33	839.79	11.54	839.79	828.61	11.18	828.61	816.04	12.57	816.04	805.82	10.22	823.13					791.59	31.54					
33	L	736.37	716.4	19.97	716.4	698.13	18.27	698.13	677.61	20.52	677.61	656.4	21.21	888.58					829.51	59.07					
34	L	885.79	875.37	10.42	875.37	863.51	11.86	863.51	850.54	12.97	850.54	837.4	13.14	848.1					811.39	36.71					
35	L	711.06	693.37	17.69	693.37	674.65	18.72	674.65	656.2	18.45	656.2	636.42	19.78	826.56					774.27	52.29					
36	L	806.25	797.68	8.57	797.68	786.49	11.19	786.49	776.94	9.55	776.94	765.33	11.61	8	0.31				782.84	27.47					
37	L	759.11	741.29	17.82	741.29	723.85	17.44	723.85	706.43	17.42	706.43	689.28	17.15	842.01					792.44	49.57					
38	L	867.01	855.28	11.73	855.28	843.89	11.39	843.89	833.59	10.3	833.59	819.32	14.27	827.23					798.18	29.05					
39	L	797.9	780.91	16.99	780.91	762.94	17.97	762.94	744.34	18.6	744.34	725.57	18.77	857.12					805.22	51.9					
40	L	833.81	820.9	12.91	820.9	807.64	13.26	807.64	794.91	12.73	794.91	780.59	14.32	811.86					776.75	35.11					
Average Consumption				14.01				15.60				13.32				15.83				Average Daily consumption				14.31	41.37

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		7/8/2013		7/9/2013				7/10/2013				7/11/2013				7/12/2013				7/13/2013	7/14/2013	7/15/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption		
41	M	800.81	785.46	15.35	785.46	770.65	14.81	770.65	755.55	15.1	755.55	740.13	15.42	907.04					862.99	44.05		
42	M	845.45	834.92	10.53	834.92	823.42	11.5	823.42	810.4	13.02	810.4	798.69	11.71	869.84					835.97	33.87		
43	M	861.53	846.68	14.85	846.68	833.02	13.66	833.02	817.31	15.71	817.31	801.98	15.33	928.44					884.98	43.46		
44	M	816.51	806.65	9.86	806.65	795.06	11.59	795.06	783.6	11.7	783.36	770.64	12.72	835.35					798.1	37.25		
45	M	848.16	833.19	14.97	833.19	816.25	16.94	816.25	802.7	13.55	802.7	785.61	17.09	924.87					879.07	45.8		
46	M	847.27	834.18	13.09	834.18	820.53	13.65	820.53	806.66	13.87	806.66	793.22	13.44	859.57					823.76	35.81		
47	M	784.01	774.01	10.01	774.01	757.35	16.66	757.35	742.02	15.33	742.02	725.57	16.45	888.87					812.4	46.29		
48	M	852.04	839.22	12.82	839.22	826.19	13.03	826.19	814.33	11.86	814.33	799.51	14.82	854.59					815.64	38.95		
49	M	775.63	760.66	14.97	760.66	745.14	15.52	745.14	728.99	16.15	728.99	713.25	15.74	838.05					791.56	46.49		
50	M	856.84	846.4	10.44	846.4	836.71	9.69	836.71	824.99	11.72	824.99	814	10.99	870.83					840.76	30.07		
51	M	779.36	762.5	16.86	762.5	745.99	16.51	745.99	729.62	16.37	729.62	716.05	13.57	871.16					834.2	42.96		
52	M	859.93	849.17	10.76	849.17	837.92	11.25	837.92	826.33	11.59	826.33	814.91	11.42	841.8					810.16	31.64		
53	M	786.52	772.81	13.71	772.81	757.48	15.33	757.48	742.87	14.51	742.87	727.57	15.5	857.12					813.9	43.22		
54	M	899.85	888.8	11.05	888.8	877.28	11.52	877.28	8													

Food Consumption: Week 8

All Food weights include the weight of the feeder the food (in grams)																							
Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		7/15/2013		7/16/2013				7/17/2013				7/18/2013				7/19/2013				7/20/2013	7/21/2013	7/22/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend	Food Out	Weekend Consumption	
1	C	737.96	722.31	15.65	722.31	706.6	15.71	706.6	690.93	15.67	690.93	675.48	15.45	832.39							782.31	50.08	
2	C	698.75	687.64	11.11	687.64	676.7	10.94	676.7	666.57	10.13	666.57	656.29	10.28	748.34							715.34	33	
3	C	750.62	735.46	15.16	735.46	719.19	16.27	719.19	704.65	14.54	704.65	688.38	16.27	899.39							849.39	50	
4	C	744.66	734.92	9.74	734.92	724.68	10.24	724.68	713.91	10.77	713.91	704.83	9.08	888.95							857.63	31.32	
5	C	764.58	748.06	16.52	748.06	732.91	15.15	732.91	718.74	14.17	718.74	701.95	16.79	820.63							773.34	47.29	
6	C	810.62	800.22	10.4	800.22	787.41	12.81	787.41	775.95	11.46	775.95	766.15	9.8	825.94							793.81	32.13	
7	C	757.05	740.71	16.34	740.71	724.7	16.01	724.7	710.68	14.02	710.68	696.17	14.51	811.55							763.86	47.69	
8	C	739.75	729.54	10.21	729.54	717.96	11.58	717.96	708.89	9.07	708.89	697.49	11.4	800.98							770.75	30.23	
109	C	728.19	712.26	15.93	712.26	698.1	14.16	698.1	682.21	15.89	682.21	667.15	15.06	804.03							757.13	46.9	
10	C	693.78	682.25	11.53	682.25	669.26	12.99	669.26	659.96	9.3	659.96	648.39	11.57	853.62							822.61	31.01	
11	C	764.37	748.7	15.67	748.7	733.63	15.07	733.63	719.35	14.28	719.35	703.91	15.44	917.74							872.83	44.91	
12	C	708.32	697.47	10.85	697.47	686.16	11.31	686.16	675.95	10.21	675.95	667.1	8.85	769.83							735.59	33.24	
13	C	752.59	735.79	16.8	735.79	719.93	15.86	719.93	705.23	14.7	705.23	689.67	15.56	881.85							832.08	49.77	
14	C	756.09	744.94	11.15	744.94	734.94	10	734.94	724.11	10.83	724.11	714.7	9.41	799.75							768.95	30.8	
15	C	787.9	773.96	13.94	773.96	760.7	13.26	760.7	745.94	14.76	745.94	731.84	14.1	829.24							787.98	41.26	
16	C	747.54	736.35	11.19	736.35	724.8	11.55	724.8	715.05	9.75	715.05	704.35	10.7	800.6							780.12	29.94	
117	C	737.89	721.27	16.62	721.27	703.95	17.32	703.95	686.31	17.64	686.31	672.14	14.17	902.65							855.25	47.4	
18	C	812.75	802.67	10.08	802.67	791.14	11.53	791.14	780.35	10.79	780.35	771.86	8.49	836.9							807.5	29.4	
19	C	915.01	900.93	14.08	900.93	887.68	13.25	887.68	874.63	13.05	874.63	858.58	16.05	873.28							834.3	38.98	
20	C	891.98	880.66	11.32	880.66	871	9.66	871	861.18	9.82	861.18	851.48	9.7	909.79							881.16	28.63	
Average Consumption					13.21			13.23			12.54			12.63			Average Daily consumption		12.90		38.70		

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		7/15/2013		7/16/2013				7/17/2013				7/18/2013				7/19/2013				7/20/2013	7/21/2013	7/22/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend	Food Out	Weekend Consumption	
21	L	800.66	784.06	16.6	784.06	768.74	15.32	768.74	753.9	14.84	753.9	737.39	16.51	902.09							859.74	42.35	
22	L	795.39	784.59	10.8	784.59	773.85	10.74	773.85	763.97	9.88	763.97	754.37	9.6	856.75							829.3	27.45	
23	L	818.9	802.99	15.91	802.99	788.29	14.7	788.29	772.97	15.32	772.97	757.69	15.28	868.58							825.22	43.36	
24	L	824.66	816.2	8.46	816.2	805.72	10.48	805.72	795.89	9.83	795.89	785.51	10.38	891.08							864.67	26.41	
25	L	856.6	839.51	17.09	839.51	822.15	17.36	822.15	807.68	14.47	807.68	794.33	13.35	878.24							836.02	42.22	
26	L	825.22	816.07	9.15	816.07	805.38	10.69	805.38	795.08	10.3	795.08	786.08	9	867.09							837.18	29.91	
27	L	835.41	817.43	17.98	817.43	801.43	16	801.43	784.17	17.26	784.17	766.88	17.29	874							825.8	48.2	
28	L	801.49	789.75	11.74	789.75	779.47	10.28	779.47	769.12	10.35	769.12	758.02	11.1	864.11							837.39	26.72	
129	L	799.58	783.64	15.94	783.64	767.13	16.51	767.13	751.02	16.11	751.02	734.78	16.24	873.19							821.39	51.8	
30	L	841.55	829.22	12.33	829.22	817.54	11.68	817.54	805.73	11.81	805.73	794.85	10.88	886.56							854.54	32.02	
31	L	843.37	828.05	15.32	828.05	811.55	16.5	811.55	795.21	16.34	795.21	781.26	13.95	880.61							835.31	45.3	
32	L	791.59	779.83	11.76	779.83	768.74	11.09	768.74	757.82	10.92	757.82	746.45	11.37	859.94							830.48	29.46	
33	L	829.51	812.77	16.74	812.77	795.16	17.61	795.16	777.08	18.08	777.08	759.21	17.87	859.27							807.68	51.59	
34	L	811.39	802.19	9.2	802.19	789.73	12.46	789.73	778.63	11.1	778.63	765.94	12.69	857.89							826.47	31.42	
35	L	774.27	757.48	16.79	757.48	738.64	18.84	738.64	722.25	16.39	722.25	704.46	17.79	846.88							796.89	49.99	
36	L	782.84	773.6	9.24	773.6	763.14	10.46	763.14	754.3	8.84	754.3	744.99	9.31	851.05							823.93	28.12	
37	L	792.44	776.59	15.85	776.59	760.47	16.12	760.47	744.36	16.11	744.36	730.11	14.25	845.92							799.81	46.11	
38	L	798.18	787.81	10.37	787.81	776.57	11.24	776.57	766.43	10.14	766.43	757.29	9.14	874.53							843.84	30.69	
39	L	805.22	790.36	14.86	790.36	774.1	16.26	774.1	758.05	16.05	758.05	742.85	15.2	854.32							810.45	43.87	
40	L	776.75	766.23	10.52	766.23	753.87	12.36	753.87	742.05	11.82	742.05	731.91	10.14	862.1							826.08	36.02	
Average Consumption					13.33			13.84			13.30			13.07			Average Daily consumption		13.10		38.15		

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		7/15/2013		7/16/2013				7/17/2013				7/18/2013				7/19/2013				7/20/2013	7/21/2013	7/22/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend	Food Out	Weekend Consumption	
41	M	862.99	849.26	13.73	849.26	833.07	16.19	833.07	819.65	13.42	819.65	805.64	14.01	873.1							831.23	41.87	
42	M	835.97	824.51	11.46	824.51	812.67	11.84	812.67	801.56	11.11	801.56	791.25	10.31	874.47							841.96	32.51	
43	M	884.98	869.91	15.07	869.91	854.06	15.85	854.06	839.24	14.82	839.24	826.01	13.23	879.92							837.36	42.56	
44	M	798.1	787.17	10.93	787.17	774.84	12.33	774.84	763.54	11.3	763.54	752.79	10.75	865.81							833.01	32.8	
45	M	879.07	864	15.07	864	847.69	16.31	847.69	833.99	13.7	833.99	818.24	15.75	889.83							846.1	43.73	
46	M	823.76	814.07	9.69	814.07	800.69	13.38	800.69	788.32	12.37	788.32	776.44	11.88	860.76							825.43	35.33	
47	M	812.4	798.67	13.73	798.67	781.76	16.84	781.76	767.64	14.12	767.64	754.21	14.43	849.81							824.4	35.4	
48	M	815.64	804.36	10.88	804.36	791.38	12.98	791.38	781.35	10.63	781.35	769.17	11.88	855.27							818.76	35.51	
49	M	791.56	777.48	14.08	777.48	755.91	21.57	755.91	741.37	14.54	741.37	727.08	14.29	877.44							833.86	43.58	
50	M	840.76	831.02	9.74	831.02	820.43	10.59	820.43	810.11	10.32	810.11	799.81	10.3	856.5							827.05	29.45	
51	M	834.2	818.15	16.05	818.15	800.78	17.37	800.8	785.53	15.25	785.53	772.46	13.07	883.78							838.87	45.06	
52	M	810.16	799.19	10.97	799.19	787.3	11.89	787.3	777.56	9.74	777.56	766.18	11.38	857.07							825.31	31.76	
53	M	813.9	800.8	13.11	800.8	784.71	16.19	784.71	771.74	12.97	771.74	756.58	15.16	879.96							828.6	42.39	
54	M	8																					

Food Consumption: Week 9

All food weights include the weight of the feeder the food (in grams)																					
Day		Monday	Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		7/22/2013	7/23/2013				7/24/2013				7/25/2013				7/26/2013				7/27/2013	7/28/2013	7/29/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption	
1	C	782.31	765.43	16.88	765.43	748.39	17.04	748.39	731.42	16.97	731.42	715.29	16.13	824.88					773.15	51.73	
2	C	715.34	705.02	10.32	705.02	693.47	11.55	693.47	681.4	12.07	681.4	669.43	11.97	810.4					775.4	35	
3	C	849.39	834.05	15.34	834.05	816.97	17.08	816.97	800.98	15.99	800.98	785.74	15.24	858.07					804.99	53.08	
4	C	857.63	848.48	9.15	848.48	836.12	12.36	836.12	824.62	11.5	824.62	813.51	11.11	837.18					804.58	32.6	
5	C	773.34	758.55	14.79	758.55	741.76	16.79	741.76	724.02	17.74	724.02	707.18	16.84	815.8					762.68	53.12	
6	C	793.81	783.98	9.83	783.98	771.46	12.52	771.46	761.23	10.23	761.23	751.14	10.09	824.82					791.43	33.39	
7	C	763.86	747.53	16.33	747.53	731.18	16.35	731.8	715.43	15.75	715.43	699.81	15.62	851.16					800.01	51.15	
8	C	770.75	760.41	10.34	760.41	748.64	11.77	748.64	737.9	10.74	737.9	727.91	9.99	828.17					795.66	32.51	
109	C	757.13	742.91	14.22	742.91	724.93	17.98	724.93	708.03	16.9	708.03	692.11	15.92	840.9					792.6	48.3	
10	C	822.61	812.96	9.65	812.96	802.06	10.9	802.06	789	13.06	789	777.31	11.69	827.12					790.41	36.71	
11	C	872.83	859.33	13.5	859.33	841.38	17.95	841.8	823.8	17.58	823.8	810.29	13.51	849.17					800.54	48.63	
12	C	736.59	725.96	10.63	725.96	715.85	10.11	715.85	705.44	10.41	705.44	693.74	11.7	828.72					796.83	31.89	
13	C	832.08	817.32	14.76	817.32	799.36	17.96	799.6	783.6	16.2	783.16	766.76	16.56	846.88					794.19	52.69	
14	C	768.95	758.09	10.86	758.09	746.54	11.55	746.54	735.45	11.09	735.45	725.04	10.41	811.84					775.31	36.53	
15	C	787.98	772.09	15.89	772.09	757.66	14.43	757.66	741.75	15.91	741.75	727.69	14.06	805.71					758.18	47.53	
16	C	780.12	770.32	9.8	770.32	759.18	11.14	759.8	747.89	11.29	747.89	737.47	10.42	810.41					777.85	32.56	
117	C	855.25	839.64	15.61	839.64	821.03	18.61	821.03	803.9	17.13	803.9	787.11	16.79	796.14					742.98	53.16	
18	C	807.5	797.47	10.03	797.47	786.22	11.25	786.22	774.01	12.21	774.01	763.84	10.17	811.46					779.66	31.8	
19	C	834.3	819.28	15.02	819.28	804.66	14.62	804.66	790.52	14.14	790.52	774.73	15.79	842.34					793.63	48.71	
20	C	881.16	870.57		870.57	860.66	9.91	860.66	849.77	10.89	849.77	839.65	10.12	841.69					808.23	33.46	
Average Consumption				12.79				14.09				13.89				13.21				42.23	
Average Daily consumption																		13.74			
Day		Monday	Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		7/22/2013	7/23/2013				7/24/2013				7/25/2013				7/26/2013				7/27/2013	7/28/2013	7/29/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption	
21	L	859.74	845.74	14	845.74	828.66	17.08	828.66	810.7	17.96	810.7	794.41	16.29	867.32					817.16	50.16	
22	L	829.3	819.83	9.47	819.83	809.81	10.02	809.81	798.68	11.13	798.68	788.07	10.61	837.09					806.03	31.06	
23	L	825.22	810.52	14.7	810.52	793.13	17.39	793.13	776.35	16.78	776.35	759.65	16.7	849.32					796.65	52.67	
24	L	864.67	855.26	9.41	855.26	843.45	11.81	843.45	832.79	10.66	832.79	822.74	10.05	887.49					855.07	32.42	
25	L	836.02	822.89	13.13	822.89	807.2	15.69	807.2	789.76	17.44	789.76	773.85	15.91	849.9					802.55	47.35	
26	L	837.18	828.2	8.98	828.2	817.76	10.44	817.76	805.99	11.77	805.99	796.02	9.97	860.15					824.17	35.98	
27	L	825.8	810.08	15.72	810.08	789.84	20.24	789.84	770.94	18.9	770.94	753.57	17.37	845.89					788.43	57.46	
28	L	837.39	826.84	10.55	826.84	814.78	12.06	814.78	802.51	12.27	802.51	790.99	11.52	843.3					809.59	33.71	
129	L	821.39	805.98	15.41	805.98	788.11	17.87	788.11	768.26	19.85	768.26	752.1	16.16	840.78					784.29	56.49	
30	L	854.54	842.96	11.58	842.96	829.9	13.06	829.9	816.66	13.24	816.66	803.65	13.01	847.57					811.99	35.58	
31	L	835.31	818.74	16.57	818.74	801.55	17.19	801.55	784.27	17.28	784.27	767.36	16.91	857.49					805.93	51.56	
32	L	830.48	819.46	11.02	819.46	807.69	11.77	807.69	795.29	12.4	795.29	782.42	12.87	832.99					795.96	37.03	
33	L	807.68	789.41	18.27	789.41	770.87	18.54	770.87	753.19	17.68	753.19	733.38	19.81	846.36					787.7	58.66	
34	L	826.47	815.91	10.56	815.91	804.2	11.71	804.2	791.01	13.19	791.01	778.87	12.14	847.22					810.6	36.62	
35	L	796.89	779.72	17.17	779.72	761.81	17.91	761.81	741.91	19.9	741.91	724.48	17.43	831.26					772.65	58.61	
36	L	822.93	812.82	10.11	812.82	802.77	10.05	802.77	792.46	10.31	792.46	781.43	11.03	830.88					801.08	29.8	
37	L	799.81	782.85	16.96	782.85	767.09	15.76	767.09	749.24	17.85	749.24	732	17.24	857.12					805.16	51.96	
38	L	843.84	834.21	9.63	834.21	822.62	11.59	822.62	808.85	13.77	808.85	798.02	10.83	855.97					822.49	33.48	
39	L	810.45	795.52	14.93	795.52	778.47	17.05	778.47	760.24	18.23	760.24	743.21	17.03	866.96					786.97	49.99	
40	L	826.08	815.35	10.73	815.35	802.39	12.96	802.39	789.04	13.35	789.04	778.43	10.61	849.3					812.27	37.03	
Average Consumption				12.95				14.51				15.20				14.17				43.88	
Average Daily consumption																		14.39			
Day		Monday	Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		7/22/2013	7/23/2013				7/24/2013				7/25/2013				7/26/2013				7/27/2013	7/28/2013	7/29/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend	Food Out	Weekend Consumption	
41	M	831.23	818	13.23	818	802.73	15.27	802.73	787.38	15.35	787.38	770.96	16.42	844.39					799.55	44.84	
42	M	841.96	832.4	9.56	832.4	821.12	11.28	821.12	807.48	13.64	807.48	795.64	11.84	819.57					784.38	35.19	
43	M	837.36	824.11	13.25	824.11	808.81	15.3	808.81	792.94	15.87	792.94	777.91	15.03	864.71					820.36	44.35	
44	M	833.01	822.67	10.34	822.67	811.42	11.25	811.42	798.6	12.82	798.6	786.44	12.16	862.87					827.51	35.36	
45	M	846.1	830.65	15.45	830.65	815.91	14.74	815.91	800.13	15.78	800.13	785.25	14.88	877.92					828.89	49.03	
46	M	825.43	815.19	10.24	815.19	802.56	12.63	802.56	789	13.56	789	775.43	13.57	798.51					761.41	37.1	
47	M	804.56	790.3	14.26	790.3	774.61	15.69	774.61	758.18	16.43	758.18	742.91	15.27	844.39					795.32	48.99	
48	M	818.76	807.49	11.27	807.49	795.85	11.64	795.85	782.23	13.82	782.23	769.51	12.72	819.1					783.5	45.97	
49	M	838.86	821.07	17.79	821.07	806.57	14.5	806.57	790.68	15.69	790.68	774.92	15.76	844.79					800.56	42.23	
50	M	827.05	817.76	9.29	817.76	806.76	11	806.6	794.6	12.6	794.16	782.76	11.4	884.8					758.39	29.5	
51	M	838.87	824.5	14.37	824.5	808.61	15.89	808.61	790.88	17.73	790.88	774.22	16.66	857.61					807.6	49.91	
52	M	825.31	817.36	7.95	817.36	805.97	11.39	805.97	793.5	12.47	793.5	782.06	11.44	795.08					761.66	33.42	
53	M	828.6	814.98	13.62	814.98	799.51	15.47	799.51	784.58	14.93	784.58	770.37	14.21	854.06					808.11	45.95	
54	M	841.5	832.38	9.12	832.38	821.76	10.62	821.76	811.08	10.68	811.08	792.84	18.24	806.24					775.32	30.92	
55	M	816.01	800.16	15.85	800.16	783.15	17.01	783.15	765.43	17.72	765.43	747.82	17.61	866.59					809.59	57.9	
56	M	852.56	840.67	11.89	840.67	831	9.67	831	818.09	12.91	818.09	807.33	10.79	822.89					788.41	34.48	
57	M	772.09	759.19	12.9	75																

Food Consumption: Week 10

Food weights include the weight of the feeder the food (in grams)																									
Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday			
Date		7/29/2013		7/30/2013				7/31/2013				8/2/2013				8/3/2013				8/3/2013	8/4/2013	8/5/2013			
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption				
1	C	773.15	758.43	14.72	758.43	743.46	14.97	743.46	729.41	14.05	729.41	714.35	15.06	824.18					775.23	48.95					
2	C	775.4	765.96	9.44	765.96	755.18	10.78	755.18	745.57	9.61	745.57	736.26	9.31	813.86					778.9	34.96					
3	C	804.99	790.28	14.71	790.28	775.43	14.85	775.43	759.91	15.52	759.91	744.12	15.79	876.08					828.63	47.45					
4	C	804.58	793.79	10.79	793.79	783.5	10.29	783.5	773.63	9.87	773.63	762.95	10.68	814.75					779.6	35.15					
5	C	762.68	747.66	15.02	747.66	732.38	15.28	732.38	717.51	14.87	717.51	703.52	13.99	864.87					811.99	52.88					
6	C	791.43	782.49	8.94	782.49	773.76	8.73	773.76	764.37	9.39	764.37	753.36	11.01	945.26					914.09	31.17					
7	C	800.01	784.14	15.87	784.14	768.89	15.25	768.89	755.64	13.25	755.64	739.79	15.85	945.26					812.77						
8	C	795.66	786.96	8.7	786.96	776.29	10.67	776.29	767.48	8.81	767.48	757.18	10.3	822.79					789.71	33.08					
109	C	792.6	777.92	14.68	777.92	762.15	15.77	762.15	749.07	13.08	749.07	733.84	15.23	855.56					808.32	47.24					
10	C	790.41	779.81	10.6	779.81	770.29	9.52	770.29	760.41	9.88	760.41	750.52	9.89	823.23					788.45	34.78					
11	C	800.54	786.54	14	786.54	770.83	15.71	770.83	756.83	14	756.83	741.27	15.56	851.76					803.64	48.12					
12	C	796.83	787.15	9.68	787.15	777.69	9.46	777.69	769.09	8.6	769.09	758.64	10.45	823.07					790.25	32.82					
13	C	794.19	778.89	15.3	778.89	763.08	15.81	763.08	747.6	15.72	747.36	732.08	15.28	845.74					793.34	52.4					
14	C	775.31	764.97	10.34	764.97	755.1	9.87	755.1	746.69	8.41	746.69	736.25	10.44	822.88					782.82	33.46					
15	C	758.18	743.87	14.31	743.87	729.64	14.23	729.64	714.77	14.87	714.77	700.22	14.55	828.67					779.91	48.76					
16	C	777.85	769.39	8.46	769.39	759.52	9.87	759.52	748.67	10.85	748.67	739.67	9	820.56					788.31	32.25					
117	C	742.98	726.93	16.05	726.93	711.84	15.09	711.84	696.65	15.19	696.65	680.62	16.03	838.41					789.29	49.12					
18	C	779.66	771.06	8.6	771.06	760.2	10.86	760.2	751.59	8.61	751.59	742.95	8.64	909.62					877.34	32.28					
19	C	793.63	779	14.63	779	764.11	14.89	764.11	750.29	13.82	750.29	736.67	13.62	895.54					852.5	43.04					
20	C	808.23	799.1	9.13	799.1	789.4	9.7	789.4	780.56	8.84	780.56	771.19	9.37	939.62					906.62	33					
Average Consumption				12.20				12.58				11.862				12.50				Average Daily consumption				12.82	
Duplicate weight recorded																									
Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday			
Date		7/29/2013		7/30/2013				7/31/2013				8/1/2013				8/2/2013				8/3/2013	8/4/2013	8/5/2013			
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption				
21	L	817.16	801.96	15.2	801.96	789.25	12.71	789.25	773.5	15.75	773.5	758.43	15.07	824.19					776.98	47.21					
22	L	806.03	797.97	8.06	797.97	788.89	9.08	788.89	780.61	8.28	780.61	771.85	8.76	824.25					792.87	31.38					
23	L	796.65	782.9	13.75	782.9	766.16	16.74	766.16	751.94	14.22	751.94	737.08	14.86	835.41					785.85	49.56					
24	L	855.07	847.98	7.09	847.98	839.48	8.5	839.48	831.31	8.17	831.31	821.9	9.41	889.56					857.48	32.08					
25	L	802.55	788.97	13.58	788.97	775.17	13.8	775.17	760.76	14.41	760.76	745.65	15.11	876.59					829.2	47.39					
26	L	824.17	814.79	9.38	814.79	803.72	11.07	803.72	792.33	11.39	792.33	782.45	9.88	827.15					794.12	33.03					
27	L	788.43	771.64	16.79	771.64	756.03	15.61	756.03	737.95	18.08	737.95	721.63	16.32	876.59					820.43	56.16					
28	L	809.59	799.42	10.17	799.42	790.49	8.93	790.49	781.19	9.3	781.19	771.59	9.6	819					785.64	33.36					
129	L	784.29	768.73	15.56	768.73	750.87	17.86	750.87	734.07	16.8	734.07	718.1	15.97	869.26					816.49	52.77					
30	L	811.99	802.86	9.13	802.86	792.64	10.22	792.64	782.96	9.68	782.96	772.1	10.86	822.91					787.72	35.19					
31	L	805.93	791.51	14.42	791.51	775.48	16.03	775.48	760.41	15.07	760.41	744.92	15.49	895.46					842.83	52.63					
32	L	795.96	786.63	9.33	786.63	774.3	12.33	774.3	765.65	8.65	765.65	755.33	10.32	820.86					787.24	33.62					
33	L	787.7	770.76	16.94	770.76	754.21	16.55	754.21	736.98	17.23	736.98	718.73	18.25	805.26					748.7	56.56					
34	L	810.6	800.4	10.2	800.4	789.85	10.55	789.85	779	10.85	779	769.11	9.89	827.53					790.59	36.94					
35	L	772.65	756.16	16.49	756.16	739.19	16.97	739.19	722	17.19	722	703.58	18.42	857.89					800.76	57.13					
36	L	801.08	791.41	9.67	791.41	780.86	10.55	780.86	771.74	9.12	769.05	760.01	9.04	819.36					786.48	32.88					
37	L	805.16	789.95	15.21	789.95	774.06	15.89	774.06	759.5	14.56	759.5	744.69	14.81	869.33					821.29	48.04					
38	L	822.49	814.2	8.29	814.2	803.17	11.03	803.17	794.89	8.28	794.89	784.02	10.87	818.55					786.65	31.9					
39	L	786.97	772.25	14.72	772.25	757.49	14.76	757.49	741.66	15.83	741.66	726.53	15.13	898.01					850.6	47.41					
40	L	812.27	801.68	10.59	801.68	790.11	11.57	790.11	780.29	9.82	780.29	768.31	11.98	856.78					818	38.78					
Average Consumption				12.23				13.04				12.63				13.00				Average Daily consumption				13.37	
Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday			
Date		7/29/2013		7/30/2013				7/31/2013				8/1/2013				8/2/2013				8/3/2013	8/4/2013	8/5/2013			
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Food Out	Weekend Consumption				
41	M	799.55	785.69	13.86	785.69	772.08	13.61	772.08	758.64	13.44	758.64	744.62	14.02	821.95					776.17	45.78					
42	M	784.38	774.75	9.63	774.75	764.56	10.19	764.56	754.16	10.4	754.16	744.49	9.67	841.76					808.5	33.26					
43	M	820.36	806.22	14.14	806.22	792.14	14.08	792.14	778.8	13.34	778.8	763.38	15.42	851.21					797.93	53.28					
44	M	827.51	816.47	11.04	816.47	806.62	9.85	806.62	796.59	10.03	796.59	785.67	10.92	822.56					784.76	37.8					
45	M	828.89	812.83	16.06	812.83	798.15	14.68	798.15	784.17	13.98	784.17	769.88	14.29	839.32					791.15	48.17					
46	M	761.41	750.2	11.21	750.2	739.05	11.15	739.05	727.55	11.5	727.55	714.96	12.59	814.01					777.86	36.15					
47	M	795.32	780.02	15.3	780.02	765.92	14.14	765.92	750.15	15.47	750.15	734.25	15.9	829.86					778.04	51.82					
48	M	783.5	773.39	10.11	773.39	762.92	10.47	762.92	753.04	9.88	753.04	741.55	11.49	819.75					782.38	36.77					
49	M	800.56	784.95	15.61	784.95	772.66	12.29	772.66	758.45	14.21	758.45	744.68	13.77	824.11					778.31	45.8					
50	M	758.98	749.9	9.08	749.9	740.21	9.69	740.21	731.35	8.86	731.35	721.53	9.82	813.11					781.35	31.75					
51	M	807.6	792.51	15.09	792.51	777.2	15.31	777.2	763.88	13.32	763.88	748.31	15.57	814.63					766.75	47.88					
52	M	761.66	750.74	10.92	750.74	739.78	10.96	739.78	729.98	9.8	729.98	719.13	10.85	814.81					780.18	45.63					
53	M	808.11	794.1	14.01	794.1	780	14.1	780	766.18	13.82	766.18	751.51	14.67	824.75					779.02	34.73					
54	M	775.32	766.16	9.16	766.16	757.79	8.37	757.79	747.72	10.07	747.72	737.28	10.44	814.75					782.43	32.32					
55	M	809.59	799.31	16.28	799.31	776.28	17.03	776.28	760.51	15.77	760.51	744.21	16.3	825.85					789.67	54.18					
56	M	788.41	780.02	8.39	780.02	772.23	7.79	772.23	764.55	7.68	764.55	750.25	14.3	814.75					798.74	31.58					
57	M</																								

Food Consumption: Week 11

All Food weights include the weight of the feeder the food (in grams)																							
Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		8/5/2013		8/6/2013				8/7/2013				8/8/2013				8/9/2013				8/10/2013	8/11/2013	8/12/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend			
1	C	775.23	759	16.23	765.86	750.01	15.85	750.01	733.8	16.83	733.18	718.4	14.78	718.69						767.39			
2	C	778.9	768.73	10.17	770.05	760.2	9.85	760.2	748.66	11.54	748.66	737.68	10.98	737.68						845.35			
3	C	828.63	813.77	14.86	818.98	801.8	17.18	801.8	786.5	15.3	786.5	768.65	17.85	768.65						843.17			
4	C	779.69	770.15	9.54	783.48	773.37	10.11	773.37	761.96	11.41	761.96	751.71	10.25	751.71						805.79			
5	C	811.99	796.82	15.17	803.66	787.47	16.19	787.47	770.74	16.73	770.74	754.91	15.83	754.91						860.42			
6	C	914.09	901.97	12.12	865.77	855.14	10.63	855.14	846.19	8.95	846.19	835.65	10.54	835.65						855.47			
7	C	812.77	795.84	16.93	787.6	773.06	14.54	773.06	757.23	15.83	757.23	743.2	14.03	743.2						864.27			
8	C	789.71	780.49	9.22	776.81	765.87	10.94	765.87	756.02	9.85	756.02	747.31	8.71	747.31						813.48			
109	C	808.32	792.8	15.52	803.53	788.88	14.65	788.88	774.87	14.01	774.87	760.74	14.13	760.74						789.03			
10	C	788.45	778.11	10.34	768.2	758.25	9.95	758.25	747.75	10.5	747.75	735.69	12.06	735.69						813.76			
11	C	803.64	787.83	15.81	820.18	805.61	14.57	805.61	789.44	16.17	789.44	773.7	15.74	773.7						814.5			
12	C	790.25	780.48	9.77	758.66	749.11	9.55	749.11	739.44	9.67	739.44	728.82	10.62	728.82						834.95			
13	C	793.34	778.48	14.86	742.42	725.48	16.94	725.48	710.65	14.83	710.65	693.65	17	693.65						896.18			
14	C	788.82	779.74	9.08	773.02	763.13	9.89	763.13	753.99	9.14	753.99	744.23	9.76	744.23						870.6			
15	C	779.91	764.12	15.79	774.99	760.69	14.3	760.69	745.61	15.08	745.61	730.28	15.33	730.28						868.84			
16	C	788.31	777.31	11	745.79	738.21	7.58	738.21	727.28	10.93	727.28	718.12	9.16	718.12						823.94			
117	C	789.29	774.61	14.68	774.3	757.39	16.91	757.39	742.13	15.26	742.13	727.33	14.8	727.33						778.73			
18	C	877.34	867.87	9.47	880.39	870.22	10.17	870.22	861.81	8.41	861.81	851.52	10.29	851.52						914.55			
19	C	852.5	837.35	15.15	837.07	822.87	14.2	822.87	808.42	14.45	808.42	793.26	15.16	793.26						841.75			
20	C	906.62	896.77	9.85	890.54	881.71		881.71	871.54	10.17	871.54	860.2	11.34	860.2						867.83			
Average Consumption		12.78				12.84				12.75				12.92				13.33				13.33	

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		8/5/2013		8/6/2013				8/7/2013				8/8/2013				8/9/2013				8/10/2013	8/11/2013	8/12/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend			
21	L	776.98	761.39	15.59	760.56	745.76	14.8	745.76	730.63	15.13	730.63	715.23	15.4	715.23						799.89			
22	L	792.87	781.44	11.43	774.83	766.05	8.78	766.05	755.91	10.14	755.91	746.08	9.83	746.08						782.72			
23	L	785.85	772.93	12.92	773.87	759.59	14.28	759.59	743.76	15.83	743.76	728.31	15.45	728.31						770.61			
24	L	857.48	847.57	9.91	818.73	809.85	8.88	809.85	798.41	11.44	798.41	788.84	9.57	788.84						801.84			
25	L	829.2	812.66	16.54	800.44	785.7	14.74	785.7	772	13.7	772	756.35	15.65	756.35						760.93			
26	L	794.12	783.64	10.48	803.99	794.25	9.74	794.25	781.96	12.29	781.96	772.39	9.57	772.39						782.14			
27	L	820.43	803.17	17.26	759.97	742.54	17.43	742.54	723.82	18.72	723.82	708.18	15.64	708.18						778.14			
28	L	785.64	774.59	11.05	756.05	746.05	10	746.05	736.69	9.36	736.69	723.43	13.26	723.43						775.77			
129	L	816.49	798.73	17.76	800.79	785.82	14.97	785.82	769.54	16.28	769.54	751.88	17.66	751.88						784.9			
30	L	787.72	777.5	10.22	746.72	735.51	11.21	735.51	724.24	11.27	724.24	713.72	10.52	713.72						774.02			
31	L	842.83	825.25	17.58	791.55	775.02	16.53	775.02	758.65	16.37	758.65	742.32	16.33	742.32						771.41			
32	L	787.24	775.85	11.39	779.28	767.83	11.45	767.83	757.91	9.92	757.91	746.46	11.45	746.46						784.33			
33	L	748.7	731.66	17.04	768.94	751.44	17.5	751.44	734.19	17.25	734.19	718.66	15.53	718.66						774.8			
34	L	790.59	781.23	9.36	800.01	789.89	10.12	789.89	778.65	11.24	778.65	767.81	10.84	767.81						787.03			
35	L	800.76	783.75	17.01	782.12	764.44	17.68	764.44	747.92	16.52	747.92	730.8	17.12	730.8						767.65			
36	L	786.48	776.45	10.03	792.61	783.61	9	783.61	775.43	8.18	775.43	764.17	11.26	764.17						796.38			
37	L	821.29	804.68	16.61	794.48	778.81	15.67	778.81	763.66	15.15	763.66	747.15	16.51	747.15						768.03			
38	L	786.65	775.79	10.86	754.17	744.78	9.39	744.78	734.12	10.66	734.12	725.07	9.05	725.07						784.76			
39	L	850.6	834.24	16.36	810.74	793.65	17.09	793.65	776.77	16.88	776.77	762.53	14.24	762.53						779.6			
40	L	818	805.5	12.5	782.54	769.71	12.83	769.71	758.82	10.89	758.82	746.48	12.34	8.39						782.23			
Average Consumption		13.60				13.10				13.36				13.36				13.71				13.71	

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		8/5/2013		8/6/2013				8/7/2013				8/8/2013				8/9/2013				8/10/2013	8/11/2013	8/12/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend			
41	M	776.17	761.78	14.39	762.61	747.67	14.94	747.67	733.43	14.24	733.43	719.04	14.39	719.04						773.51			
42	M	808.5	797.46	11.04	796.7	786.85	9.85	786.85	776.44	10.41	776.44	767.43	9.01	767.43						792.36			
43	M	797.93	790.56	7.37	751.11	736.06	15.05	736.06	721.46	14.6	721.46	706.11	15.35	706.11						771.3			
44	M	784.76	773.25	11.51	815.01	804.44	10.57	804.44	793.3	11.14	793.3	781.05	12.25	781.05						790.44			
45	M	791.15	776.44	14.71	742.14	724.94	17.2	724.94	710.93	14.01	710.93	695.54	15.39	695.54						775.92			
46	M	777.86	767.39	9.96	772.91	761.86	11.05	761.86	751.92	9.94	751.92	739.6	12.32	739.6						771.51			
47	M	778.04	763.82	14.22	767.03	750.33	16.7	750.33	735.05	15.28	735.05	719.75	15.3	719.75						769.03			
48	M	782.98	770.84	12.04	775.93	765.05	10.88	765.05	752.39	12.39	752.39	740.62	10.02	740.62						770.42			
49	M	778.31	762.73	15.58	740.19	727.04	13.15	727.04	714.41	12.63	714.41	700.32	14.09	700.32						767.04			
50	M	781.36	770.96	10.4	796.83	787.86	8.97	787.86	778.88	8.98	778.88	768.85	10.03	768.85						782.98			
51	M	766.75	750.62	16.13	765.93	751.35	14.58	751.35	737.7	13.65	737.7	721.46	16.24	721.46						766.74			
52	M	778.06	767.91	12.27	746.34	736.31	10.03	736.31	726.59	9.72	726.59	716.88	9.71	716.88						775.7			
53	M	790.12	765.52	13.5	807.93	794.77	13.16	794.77	779.86	14.91	779.86	764.96	14.9	764.96						759.65			
54	M	782.43	772.38	10.05	739.99	730.06	9.93	730.06	720.53	9.53	720.53	710.85	9.68	710.85						787.56			
55	M	769.67	751.24	18.43	778.74	760.07	18.67	760.07	744.07	16	744.07	726.96	17.11	726.96						758.33			
56	M	798.74	789.26	9.48	758.35	747.36	10.99	747.36	736.94	10.42	736.94	728.37	8.57	728.37						799.72			
57	M	780.58	763.58	17	759.99	745.52	14.47	745.52	729.85	15.67	729.85	713.54	16.31	713.54						755.93			
58	M</																						

Food Consumption: Week 12

All Food weights include the weight of the feeder the food (in grams)																						
Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		8/12/2013		8/13/2013				8/14/2013				8/15/2013				8/16/2013				8/17/2013	8/18/2013	8/19/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed			
1	C	767.39	752.06	15.33	752.06	733.17	18.89	733.17	715.7	17.47	715.7	701.41	14.29	884.6			Weekend		832.25	52.35		
2	C	845.35	836.2	9.15	836.2	822.4	13.8	822.4	809.74	12.66	809.74	798.84	10.9	798.81					768.35	30.46		
3	C	843.17	827.02	16.15	827.02	805.97	21.05	805.97	789.95	16.02	789.95	775.02	14.93	864.05					814.96	49.09		
4	C	805.79	796.49	9.3	796.49	782.94	13.55	782.94	772.17	10.77	772.17	760.81	11.36	793.47					761.73	31.74		
5	C	860.42	844.26	16.16	844.26	825.91	18.35	825.91	807.77	18.14	807.77	791.24	16.53	863.19					809.43	53.76		
6	C	855.47	845.17	10.3	845.17	833.84	11.33	833.84	821.45	12.39	821.45	811.35	10.1	811.35					779.26	32.09		
7	C	864.27	849.04	15.23	849.04	830.7	18.34	830.7	813.65	17.05	813.65	796.96	16.69	916.29					868.64	47.65		
8	C	813.48	803.27	10.21	803.27	791.22	12.05	791.22	779.97	11.25	779.97	770.59	9.38	791.97					761.18	30.79		
109	C	789.03	773.63	15.4	773.63	757.53	16.1	757.53	739.41	18.12	739.41	724.16	15.25	853.56					806.68	46.88		
10	C	813.76	804.56	9.2	804.56	791.04	13.52	791.04	780.3	10.74	780.3	769.5	10.8	805.43					775.81	29.62		
11	C	814.5	798.08	16.42	798.08	780.67	17.41	780.67	764.49	16.18	764.49	748.43	16.06	900.79					852.28	48.51		
12	C	834.95	825.04	9.91	825.04	813.77	11.27	813.77	801.89	11.88	801.89	792.22	9.67	792.24					763.03	29.21		
13	C	896.18	880.5	15.68	880.5	860.9	19.6	860.9	841.82	19.08	841.82	827.92	13.9	827.96					775.99	48.97		
14	C	870.6	861.65	8.95	861.65	849.41	12.24	849.41	836.76	12.65	836.76	827.69	9.07	827.68					794.04	33.64		
15	C	868.84	853.18	15.66	853.18	835.68	17.5	835.68	819.48	16.2	819.48	805.65	13.83	838.68					792.33	46.35		
16	C	823.94	815.57	8.37	815.57	803.55	12.02	803.55	792.19	11.36	792.19	780.6	11.59	795.31					768.64	26.67		
117	C	778.73	765.41	13.32	765.41	748.72	16.69	748.72	731.51	17.21	731.51	715.91	15.6	865.65					817.83	47.82		
18	C	914.55	904.84	9.71	904.84	892.96	11.88	892.96	880.56	12.4	880.56	871.25	9.31	871.25					842.36	28.89		
19	C	841.75	826.7	15.05	826.7	810.37	16.33	810.37	793.89	16.48	793.89	779.33	14.56	951.34					907.09	44.25		
20	C	867.83	857.32	10.51	857.32	844.96	12.36	844.96	832.35	12.61	832.35	823.08	9.27	823.08					795.62	27.46		
Average Consumption					12.50			15.21			14.53			12.65			Average Daily consumption		13.46		39.31	

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		8/12/2013		8/13/2013				8/14/2013				8/15/2013				8/16/2013				8/17/2013	8/18/2013	8/19/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed			
21	L	799.89	783.7	16.19	783.7	764.92	18.78	764.92	748.14	16.78	748.14	731.45	16.69	805.77			Weekend		758.96	46.81		
22	L	782.72	773.54	9.18	773.54	761.15	12.39	761.15	747.72	13.43	747.72	737.44	10.28	792.52					762.29	30.23		
23	L	770.61	756.31	14.3	756.31	739.21	17.1	739.21	720.84	18.37	720.84	705.66	15.18	804.89					760.59	44.3		
24	L	801.84	791.71	10.13	791.71	778.77	12.94	778.77	768.06	10.71	768.06	758.62	9.44	798.1					771.01	27.09		
25	L	760.93	746.65	14.28	746.65	729.23	17.42	729.23	713.11	16.12	713.11	696.21	16.9	803.23					756.05	47.18		
26	L	782.14	771.66	10.48	771.66	759.64	12.02	759.64	746.14	13.5	746.14	736.04	10.1	798.66					766.74	32.92		
27	L	778.14	760.15	17.99	760.15	740.95	19.2	740.95	722.67	18.28	722.67	704.04	18.63	803.55					748	55.55		
28	L	775.77	766.29	9.48	766.29	752.96	13.33	752.96	742.91	10.05	742.91	732.15	10.76	793.03					763.71	29.32		
129	L	784.9	767.94	16.96	767.94	747.88	20.06	747.88	729.44	18.44	729.44	713.26	16.18	802.25					747.86	54.39		
30	L	774.02	763.3	10.72	763.3	748.29	15.01	748.29	735.37	12.92	735.37	723.89	11.48	90.94					757.44	33.5		
31	L	771.41	753.02	18.39	753.02	734.47	18.55	734.47	715.19	19.28	715.19	698.16	17.03	801.12					751.98	49.14		
32	L	784.33	774.63	9.7	774.63	761.22	13.41	761.22	745.44	15.78	745.44	735.07	10.37	791.49					758.61	32.88		
33	L	774.8	757.02	17.78	757.02	736.37	20.65	736.37	717.15	19.22	717.15	700.15	17	808.18					752.89	55.29		
34	L	787.03	776.35	10.68	776.35	763.72	12.63	763.72	749.4	14.32	749.4	737.66	11.74	801.25					767.2	34.05		
35	L	767.65	749.51	18.14	749.51	729.65	19.86	729.65	711.21	18.44	711.21	693.49	17.72	803.2					748.59	54.61		
36	L	796.38	785.67	10.71	785.67	773.83	11.84	773.83	760.95	12.88	760.95	750.86	10.09	793.55					765.32	28.23		
37	L	768.03	750.77	17.26	750.77	733.22	17.55	733.22	713.89	19.33	713.89	698.39	15.5	800.52					750.55	49.97		
38	L	784.76	775.27	9.49	775.27	763.72	11.55	763.72	751.45	12.27	751.45	741.24	10.21	795.18					766.36	28.82		
39	L	779.6	763.04	16.56	763.04	744.35	18.69	744.35	727.37	16.98	727.37	712.16	15.21	784.45					739.12	45.33		
40	L	782.23	772.25	9.98	772.25	757.07	15.18	757.07	742.48	14.59	742.48	729.64	12.84	797.02					762.02	35		
Average Consumption					13.42			15.91			15.58			13.67			Average Daily consumption		14.19		40.73	

Day		Monday		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday
Date		8/12/2013		8/13/2013				8/14/2013				8/15/2013				8/16/2013				8/17/2013	8/18/2013	8/19/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed			
41	M	773.51	758.88	14.63	758.88	741.43	17.45	741.43	725.44	15.99	725.44	710.56	14.88	805.14			Weekend		760.72	44.42		
42	M	792.36	782.31	10.05	782.31	769.94	12.37	769.94	757.47	12.47	757.47	747.04	10.43	794.74					765.3	29.44		
43	M	771.3	755.18	16.12	755.18	738.7	16.48	738.7	723.23	15.47	723.23	709.51	13.72	803.49					755.22	48.27		
44	M	790.44	779.37	11.07	779.37	764.87	14.5	764.87	751.76	13.11	751.76	740.88	10.88	796.57					760.03	36.54		
45	M	775.92	760.59	15.33	760.59	744.09	16.5	744.09	728.55	15.54	728.55	713.84	14.71	804.9					759.15	45.75		
46	M	771.51	760.81	10.7	760.81	745.71	15.1	745.71	731.59	14.12	731.59	721.42	10.17	789.48					755.06	34.42		
47	M	769.93	744.01	15.92	744.01	726.58	17.35	726.58	710.18	16.5	710.18	692.81	17.37	802.09					751.93	45.99		
48	M	770.42	758.12	12.3	758.12	743.25	14.86	743.25	732.39	10.87	732.39	719.9	12.49	803.79					758.39	35.4		
49	M	767.04	752.65	14.39	752.65	736.67	15.98	736.67	720	16.67	720	706.25	13.75	803.63					756.86	46.77		
50	M	782.98	772.52	10.46	772.52	761.95	10.57	761.95	749.52	12.43	749.52	739.96	9.56	794.64					764.72	29.92		
51	M	766.74	751.66	15.08	751.66	734.78	16.88	734.78	719.52	15.26	719.52	706.25	13.27	802.08					756.91	45.17		
52	M	775.7	765.36	10.34	765.36	754.03	11.33	754.03	742.61	11.42	742.61	731.57	11.04	793.43					762.62	30.81		
53	M	759.65	745.4	14.25	745.4	729.26	16.14	729.26	713.01	16.25	713.01	698.12	14.89	804.07					758.55	45.52		
54	M	787.56	778.49	9.07	778.49	766.47	12.02	766.47	753.8	12.67	753.8	742.83	10.97	791.31					763.2	28.11		
55	M	758.33	739.47	18.86	739.47	720.47	19	720.47	701.6	18.89	701.6	683.08	18.52	804.32					749.39	54.93		
56	M	739.72	731.42	8.3	731.42	718.51	12.91	718.51	707.3	11.21	707.3	691.79	9.51	792.27					761.45	30.		

Food Consumption: Week 13

All Food weights include the weight of the feeder the food (in grams)																					
Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		8/20/2013				8/21/2013				8/22/2013				8/23/2013				8/24/2013	8/25/2013	8/26/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend		Food Out	Weekend Consumption	
1	C	832.25	816.2	16.05	816.2	798.91	17.29	798.91	781.73	17.18	781.73	766.93	14.8	766.93					715.3	51.63	
2	C	768.35	756.49	11.86	756.49	745.68	10.81	745.68	735.82	9.86	735.82	725.97	9.85	725.97					692.8	33.17	
3	C	814.96	798.65	16.31	798.65	782.87	15.78	782.87	766.41	16.46	766.41	752.34	14.07	752.34					701.57	50.77	
4	C	761.73	752.87	8.86	752.87	742.55	10.32	742.55	731.82	10.73	731.82	723.62	8.2	723.62					692.12	31.5	
5	C	809.43	792.79	16.64	792.79	775.17	17.62	775.17	760.54	14.63	760.54	743.55	16.99	743.55					692.13	51.42	
6	C	779.26	768.84	10.42	768.84	757.86	10.98	757.86	747.95	9.91	747.95	738.72	9.23	738.72					706.07	32.65	
7	C	868.64	854.16	14.48	854.16	837.68	16.48	837.68	823.45	14.23	823.45	807.57	15.88	807.57					758.61	48.96	
8	C	761.18	750.76	10.42	750.76	739.27	11.49	739.27	730.1	9.17	730.1	719.89	10.21	719.89					689.65	30.24	
109	C	806.68	792.04	14.64	792.04	776.06	15.98	776.06	761.2	14.86	761.2	745.5	15.7	745.5					698.06	47.44	
10	C	775.81	765.57	10.24	765.57	754.77	10.8	754.77	744.79	9.98	744.79	732.35	12.44	732.35					698.92	33.43	
11	C	852.28	837.2	15.08	837.2	820.85	16.35	820.85	804.9	15.95	804.9	789.83	15.07	789.83					740.06	49.77	
12	C	763.03	751.46	11.57	751.46	741.58	9.88	741.58	731.09	10.49	731.09	723	8.09	723					692.84	30.16	
13	C	778.99	761.64	17.35	761.64	744.1	17.54	744.1	726.46	17.64	726.46	711.45	15.01	711.45					661.41	50.04	
14	C	794.04	782.78	11.26	782.78	773.63	9.15	773.63	762.82	10.81	762.82	753.2	9.62	753.2					722.84	30.36	
15	C	792.33	777.68	14.65	777.68	760.48	17.2	760.48	746.08	14.4	746.08	731.29	14.79	731.29					682.5	48.79	
16	C	768.64	758.94	9.7	758.94	748.77	10.17	748.77	738.22	10.55	738.22	729.97	8.25	729.97					697.66	32.31	
117	C	817.83	803.3	14.53	803.3	789.11	14.19	789.11	775.11	14	775.11	759.72	15.39	759.72					712.88	46.84	
18	C	842.36	832.73	9.63	832.73	824.04	8.69	824.04	810.75	13.29	810.75	805.22	5.53	805.22					776.31	28.91	
19	C	907.09	892.44	14.65	892.44	875.39	17.05	875.39	862.31	13.08	862.31	848.35	13.96	848.35					803.47	44.88	
20	C	795.62	785.74	9.88	785.74	776.02	9.72	776.02	765.66	10.36	765.66	754.96	10.7	754.96					725.35	29.61	
Average Consumption				12.91			13.37			12.88			12.19				Average Daily consumption		13.07	40.14	

Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		8/20/2013				8/21/2013				8/22/2013				8/23/2013				8/24/2013	8/25/2013	8/26/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend		Food Out	Weekend Consumption	
21	L	758.96	743.01	15.95	743.01	729.22	13.79	729.22	715.05	14.17	715.05	699.5	15.55	699.5					651.28	48.22	
22	L	762.29	753.58	8.71	753.58	743.08	10.5	743.08	733.14	9.94	733.14	722.08	11.06	722.08					689.75	32.33	
23	L	760.59	745.43	15.16	745.43	729.99	15.44	729.99	714.22	15.77	714.22	697.74	16.48	697.74					651.17	46.57	
24	L	771.01	761.84	9.17	761.84	752.61	9.23	752.61	743.71	8.9	743.71	734.04	9.67	734.04					705.1	28.94	
25	L	756.05	741.09	14.96	741.09	725.7	15.39	725.7	710.43	15.27	710.43	695.58	14.85	695.58					648.54	47.04	
26	L	765.74	754.81	10.93	754.81	745.01	9.8	745.01	735.55	9.46	735.55	723.2	12.35	723.2					691.05	32.15	
27	L	748	730.16	17.84	730.16	713.3	16.86	713.3	694.73	18.57	694.73	677	17.73	677					619.46	57.54	
28	L	763.71	753.94	9.77	753.94	744.54	9.4	744.54	732.72	11.82	732.72	723.08	9.64	723.08					691.81	31.27	
129	L	747.86	731.02	16.84	731.02	712.01	19.01	712.01	695.89	16.12	695.89	679.19	16.7	679.19					626.9	52.29	
30	L	757.44	747.01	10.43	747.01	735.94	11.07	735.94	727.14	8.8	727.14	715.64	11.5	715.64					679.34	36.3	
31	L	751.98	734.81	17.17	734.81	717.12	17.69	717.12	701.65	15.47	701.65	684.35	17.3	684.35					634.98	49.37	
32	L	758.61	746.22	12.39	746.22	735.57	10.65	735.57	724.94	10.63	724.94	715.72	9.22	715.72					682.55	33.17	
33	L	752.89	733.95	18.94	733.95	716.03	17.92	716.03	695.8	20.23	695.8	676.29	19.51	676.29					623.18	53.11	
34	L	767.2	756.02	11.18	756.02	744.68	11.34	744.68	733.22	11.46	733.22	724.01	9.21	724.01					689.93	34.08	
35	L	748.59	730.27	18.32	730.27	714.01	16.26	714.01	696.6	17.41	696.6	679.53	17.07	679.53					625.39	54.14	
36	L	765.32	756.52	8.8	756.52	746.59	9.93	746.59	735.87	10.72	735.87	727.02	8.85	727.02					695.38	31.64	
37	L	750.55	734.37	16.18	734.37	718.28	16.09	718.28	701.98	16.3	701.98	686.48	15.5	686.48					636.3	50.18	
38	L	766.36	756.59	9.77	756.59	745.86	10.73	745.86	735.7	10.16	735.7	726.47	9.23	726.47					697.83	28.64	
39	L	739.12	723.28	15.84	723.28	706.81	16.47	706.81	690.87	15.94	690.87	674.34	16.53	674.34					623.74	50.6	
40	L	762.02	751.97	10.05	751.97	739.51	12.46	739.51	726.63	12.88	726.63	715.69	10.94	715.69					684.51	31.18	
Average Consumption				13.42			13.50			13.50			13.44				Average Daily consumption		13.62	41.44	

Day		Tuesday				Wednesday				Thursday				Friday				Saturday	Sunday	Monday	
Date		8/20/2013				8/21/2013				8/22/2013				8/23/2013				8/24/2013	8/25/2013	8/26/2013	
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Weekend		Food Out	Weekend Consumption	
41	M	760.72	743.8	16.92	743.8	729.79	14.01	729.79	715.73	14.06	715.73	701.51	14.22	701.51					656.02	45.49	
42	M	765.3	754.11	11.19	754.11	744.69	9.42	744.69	734.95	9.74	734.95	723.15	11.8	723.15					691.51	31.64	
43	M	755.22	740.39	14.83	740.39	725.12	15.27	725.12	711.43	13.69	711.43	695.05	16.38	695.05					650.33	44.72	
44	M	760.03	749.17	10.86	749.17	737.35	11.82	737.35	725.03	12.32	725.03	713.6	11.43	713.6					678.19	35.41	
45	M	759.15	744.12	15.03	744.12	728.04	16.08	728.04	712.26	15.78	712.26	697.29	14.97	697.29					649.69	47.6	
46	M	755.06	743.96	11.1	743.96	732.52	11.44	732.52	722.46	10.06	722.46	712.51	9.95	712.51					676.56	35.95	
47	M	757.18	740.58	16.6	740.58	724.85	15.73	724.85	709.57	15.28	709.57	692.84	16.73	692.84					643.38	49.46	
48	M	758.39	746.99	11.4	746.99	734.28	12.71	734.28	723.27	11.01	723.27	710.77	12.5	710.77					685.68	25.09	
49	M	756.86	741.4	15.46	741.4	726.45	14.95	726.45	708.53	17.92	708.53	693.86	14.67	693.86					643.92	49.94	
50	M	764.72	753.85	10.87	753.85	743.38	10.47	743.8	732.72	10.66	732.72	723.13	9.59	723.13					693.32	29.81	
51	M	756.91	741.57	15.34	741.57	726.88	14.69	726.88	711.52	15.36	711.52	697.02	14.5	697.02					647.99	49.03	
52	M	762.62	752.23	10.39	752.23	741.73	10.5	741.73	730.8	10.93	730.8	722.06	8.74	722.06					687.62	34.44	
53	M	758.55	744.74	13.81	744.74	729.52	15.22	729.52	714.05	14.87	714.05	699.81	14.84	699.81					650.25	49.56	
54	M	763.2	754.07	9.13	754.07	745.65	8.42	745.65	735.5	10.15	735.5	726.94	8.56	726.94					696.59	30.35	
55	M	749.39	729.93	19.46	729.93	711.33	18.6	711.33	693.84	17.49	693.84	677.09	16.75	677.09					620.52	56.57	
56	M	761.45	752.81	8.64	752.81	743.61	9.2	743.61	730.82	12.79	730.82	721.29	9.53	721.29					691.59	29.7	
57	M	756.28	741.35	14.93	741.35	72															

Food Consumption: Week 14

Food weights include the weight of the feeder the food (in grams)																	
Day		Monday	Tuesday		Wednesday			Thursday			Friday			Saturday	Sunday	Monday	Tuesday
Date		8/26/2013	8/27/2013		8/28/2013			8/29/2013			8/30/2013			8/31/2013	9/1/2013	9/2/2013	9/3/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Weekend Consumption
1	C	715.3	699.98	15.32	699.98	683.98	16	683.98	672.68	11.3	672.68	655.09	17.59	681.27	612.26	69.01	
2	C	692.8	682.85	9.95	682.85	672.63	10.22	672.63	662.91	9.72	662.91	648.4	14.51	705.48	661.92	43.56	
3	C	701.57	685.79	15.78	685.79	668.27	17.52	668.27	651.6	16.91	651.36	639.54	11.82	676.62	612.18	64.44	
4	C	692.12	682.49	9.63	682.49	671.84	10.65	671.84	661.6	10.48	661.36	649.27	12.09	686.33	640.86	45.47	
5	C	692.13	676.5	15.63	676.5	658.91	17.59	658.91	642.21	16.7	642.21	626.77	15.44	676.42	608.69	67.73	
6	C	706.07	696.4	9.67	696.4	686.61	9.79	686.61	674.54	12.07	674.54	665.71	8.83	747.44	702.89	44.55	
7	C	758.61	744.32	14.29	744.32	728.8	15.52	728.8	714.42	14.38	714.42	699.27	15.15	744.92	680.59	64.33	
8	C	689.65	680.84	8.81	680.84	671.08	9.76	671.08	661.6	9.92	661.16	652.36	8.8	706.43	665.05	41.38	
109	C	698.06	683.9	14.16	683.9	668.69	15.21	668.69	653.59	15.1	653.59	640.87	12.72	696.79	634.43	62.36	
10	C	698.92	689.97	8.95	689.97	678.7	11.27	678.7	669.31	9.39	669.31	659.94	9.37	768.34	725.6	42.74	
11	C	740.06	724.56	15.5	724.56	708.69	15.87	708.69	694.47	14.22	694.47	678.44	16.03	771.98	707.65	64.33	
12	C	692.84	684.34	8.5	684.34	675.23	9.11	675.23	665.61	9.62	665.61	656.3	9.31	656.3	616.35	39.95	
13	C	661.41	647.4	14.01	647.4	630.71	16.69	630.71	615.7	15.01	615.7	598.75	16.95	663.58	596.32	67.26	
14	C	722.84	715.01	7.83	715.01	704.27	10.74	704.27	694.8	9.89	694.38	683.27	11.11	683.27	640.26	43.01	
15	C	682.5	668.11	14.39	668.11	651.67	16.44	651.67	636.53	15.14	636.53	620.08	16.45	704.58	643.45	61.13	
16	C	697.66	687.76	9.9	687.76	676.38	11.38	676.8	666.05	10.33	666.05	655.75	10.3	655.75	614.48	41.27	
117	C	712.88	698.53	14.35	698.53	680.69	17.84	680.69	668.56	12.13	668.56	651.66	16.9	719.51	656.58	62.93	
18	C	776.31	767.48	8.83	767.48	757.76	9.72	757.76	748.89	8.87	748.89	738.27	10.62	738.27	700.04	38.23	
19	C	803.47	790.04	13.43	790.04	777	13.04	777	761.19	15.81	761.19	748.76	12.43	748.76	692.02	56.74	
20	C	725.35	717.55	7.8	717.55	707.18	10.37	707.8	694.64	12.54	694.64	685.92	8.72	685.92	646.35	39.57	
Average Consumption				11.84		13.24		12.48		12.76		12.76		Average Daily consumption		12.91	53.00
Day		Monday	Tuesday		Wednesday			Thursday			Friday			Saturday	Sunday	Monday	Tuesday
Date		8/26/2013	8/27/2013		8/28/2013			8/29/2013			8/30/2013			8/31/2013	9/1/2013	9/2/2013	9/3/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Weekend Consumption
21	L	651.28	636.56	14.72	636.56	622.29	14.27	622.29	606.69	15.6	606.69	589.14	17.55	671.2	607.24	63.96	
22	L	689.75	681.36	8.39	681.36	670.86	10.5	670.86	661.99	8.87	661.99	651.05	10.94	651.05	611.19	39.86	
23	L	651.17	637.1	14.07	637.1	621	16.1	621	605.97	15.03	605.97	588.78	17.19	678.95	615.86	63.09	
24	L	705.1	696.97	8.13	696.97	685.95	11.02	685.95	676.37	9.58	676.37	666.25	10.12	666.25	628.42	37.83	
25	L	648.54	632.47	16.07	632.47	617.46	15.01	617.46	601.96	15.5	601.96	586.31	15.65	657.48	595.71	61.77	
26	L	691.05	681.35	9.7	681.35	670.02	11.33	670.02	659.06	10.96	659.06	647.57	11.49	647.57	605.35	42.22	
27	L	619.46	600.86	18.6	600.86	583.74	17.12	583.74	565.12	18.62	565.12	545.52	19.6	672.48	598.75	73.73	
28	L	691.81	682.87	8.94	682.87	671.02	11.85	671.02	659.78	11.24	659.78	649.26	10.52	649.26	606.71	42.55	
129	L	626.9	610.06	16.84	610.06	593.84	16.22	593.84	575.92	17.92	575.92	559.35	16.57	673.72	605.46	68.26	
30	L	679.34	667.57	11.77	667.57	655.45	12.12	655.45	643.39	12.06	643.39	631.31	12.08	670.85	625.61	45.24	
31	L	634.98	616.44	18.54	616.44	599.54	16.9	599.54	581.99	17.55	581.99	564.42	17.57	680.47	616.76	63.71	
32	L	682.55	671.32	11.23	671.32	659.39	11.93	659.39	645.78	13.61	645.78	633.75	12.03	718.07	674.09	43.98	
33	L	623.18	602.92	20.26	602.92	585.06	17.86	585.06	566.48	18.58	566.48	548.06	18.42	666.62	595.67	70.95	
34	L	689.93	679.02	10.91	679.02	668.28	10.74	668.28	656.88	11.14	656.88	645.34	11.54	698.51	656.11	42.4	
35	L	625.39	608.25	17.14	608.25	589.09	19.16	589.09	572.43	16.66	572.43	553.65	18.78	631.83	557.81	74.02	
36	L	695.38	687.22	8.16	687.22	677.05	10.17	677.05	666.41	10.64	666.41	654.55	11.86	686.9	649.4	37.5	
37	L	636.3	619.81	16.49	619.81	603.85	15.96	603.85	586.79	17.06	586.79	570.97	15.82	661.81	597.71	64.1	
38	L	697.83	687.95	9.88	687.95	678.32	9.63	678.32	667.55	10.77	667.55	657.76	9.79	704	666.7	37.3	
39	L	623.74	607.6	16.14	607.6	591.02	16.58	591.02	572.26	18.76	572.26	554.57	17.69	626.46	561.52	64.94	
40	L	684.51	673.27	11.24	673.27	662.43	10.84	662.43	652.27	10.16	652.27	638.7	13.57	691.92	648.9	43.02	
Average Consumption				13.36		13.77		14.03		14.44		14.44		Average Daily consumption		13.70	54.02
Day		Monday	Tuesday		Wednesday			Thursday			Friday			Saturday	Sunday	Monday	Tuesday
Date		8/26/2013	8/27/2013		8/28/2013			8/29/2013			8/30/2013			8/31/2013	9/1/2013	9/2/2013	9/3/2013
ID	Group	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Food Out	Food Consumed	Food In	Weekend		Weekend Consumption
41	M	656.02	641.53	14.49	641.53	627.03	14.5	627.03	611.66	15.37	611.66	596.88	14.78	668.53	608.16	60.37	
42	M	691.51	681.6	9.91	681.6	669.6	12	669.6	659.55	10.05	659.55	647.61	11.94	647.61	605.17	42.44	
43	M	650.33	634.77	15.56	634.77	6 8.33	16.44	618.33	602.65	15.68	602.65	589.23	13.42	689.5	627.65	61.85	
44	M	678.19	666.47	11.72	666.47	654.01	12.46	654.01	641.48	12.53	641.48	629.48	12	646.65	599.01	47.64	
45	M	649.69	634.73	14.96	634.73	619.77	14.96	619.77	604.68	15.09	604.68	591.24	13.44	681.81	621.08	60.73	
46	M	676.56	665.25	11.31	665.25	655	10.25	655	643.95	11.05	643.95	636.92	7.03	688.44	588.13	100.31	
47	M	642.38	629.64	12.74	629.64	612.84	16.54	612.84	598.9	13.94	598.9	579.89	17.21	688.39	622.95	65.44	
48	M	685.68	674.2	11.48	674.2	661.15	13.05	661.15	649.77	11.38	649.77	637.01	12.76	637.01	585.78	48.23	
49	M	643.93	628.59	15.33	628.59	613.05	15.54	613.05	597.17	15.88	597.17	580.6	16.57	669.44	608.37	61.07	
50	M	693.32	682.64	10.68	682.64	671.38	11.26	671.38	662.93	8.45	662.93	651.57	11.36	651.57	608.9	42.67	
51	M	647.99	632.87	15.12	632.87	616	16.87	616	601.94	14.06	601.94	585.92	16.02	669.81	605.75	63.66	
52	M	687.82	678.1	9.52	678.1	666.4	11.7	666.4	656.67	9.73	656.67	645.89	10.78	673.17	632.24	40.93	
53	M	650.25	635.79	14.46	635.79	620.5	15.29	620.5	605.76	14.74	605.76	591.78	13.98	672.56	610.56	62	
54	M	696.59	686.32	10.27	686.32	6 6.68	9.64	676.68	667.41	9.27	667.41	658.1	9.31	689.64	649.79	39.85	
55	M	620.52	602.16	18.36	602.16	585.47	16.69	585.47	566.6	18.87	566.6	550.69	15.91	662.33	591.26	71.07	
56	M	691.59	683.12	8.47	683.12	671.06	12.06	671.06	660.32	10.74	660.32	652.05	8.27	683.87	641.78	42.09	
57	M</																

Food Consumption: Week 15

All Food weights include the weight of the feeder + the food (in grams)

Day		Tuesday		Wednesday			
Date		9/3/2013		9/4/2013			
ID	Group	Food In	Food Out	Food Out	Food Consumed	Food In	Food Out
1	C	612.26	FASTED				
2	C	661.92	FASTED				
3	C	612.18	FASTED				
4	C	640.86	FASTED				
5	C	608.69	FASTED				
6	C	702.89	FASTED				
7	C	680.59	FASTED				
8	C	665.05	FASTED				
109	C	634.43	FASTED				
10	C	725.6	FASTED				
11	C	707.65		691.17	16.48	FASTED	
12	C	616.35		607.44	8.91	FASTED	
13	C	596.32		579.62	16.7	FASTED	
14	C	640.26		630.17	10.09	FASTED	
15	C	643.45		628.45	15	FASTED	
16	C	614.48		603.61	10.87	FASTED	
117	C	656.58		641.85	14.73	FASTED	
18	C	700.04		689.11	10.93	FASTED	
19	C	692.02		677.11	14.91	FASTED	
20	C	646.35		636.87	9.48	FASTED	
Average Consumption				12.81			

Day		Tuesday		Wednesday			
Date		9/3/2013		9/4/2013			
ID	Group	Food In	Food Out	Food Out	Food Consumed	Food In	Food Out
21	L	607.24	FASTED				
22	L	611.19	FASTED				
23	L	615.86	FASTED				
24	L	628.42	FASTED				
25	L	595.71	FASTED				
26	L	605.35	FASTED				
27	L	598.75	FASTED				
28	L	606.71	FASTED				
129	L	605.46	FASTED				
30	L	625.61	FASTED				
31	L	616.76		602.17	14.59	FASTED	
32	L	674.09		663.56	10.53	FASTED	
33	L	595.67		578.23	17.44	FASTED	
34	L	656.11		646.27	9.84	FASTED	
35	L	557.81		541.77	16.04	FASTED	
36	L	648.4		639.16	10.24	FASTED	
37	L	597.71		583.89	13.82	FASTED	
38	L	666.7		656.15	10.55	FASTED	
39	L	561.52		546.45	15.07	FASTED	
40	L	648.9		638.02	10.88	FASTED	
Average Consumption				12.90			

Day		Tuesday		Wednesday			
Date		9/3/2013		9/4/2013			
ID	Group	Food In	Food Out	Food Out	Food Consumed	Food In	Food Out
41	M	608.16	FASTED				
42	M	605.17	FASTED				
43	M	627.65	FASTED				
44	M	599.01	FASTED				
45	M	621.06	FASTED				
46	M	588.13	FASTED				
47	M	622.95	FASTED				
48	M	588.78	FASTED				
49	M	608.37	FASTED				
50	M	608.9	FASTED				
51	M	605.75		590.84	14.91	FASTED	
52	M	632.24		623.21	9.03	FASTED	
53	M	610.56		595.54	15.02	FASTED	
54	M	649.79		640.57	9.22	FASTED	
55	M	591.26		574.19	17.07	FASTED	
56	M	641.78		630	11.78	FASTED	
57	M	604.45		590.13	14.32	FASTED	
58	M	636.74		626.16	10.58	FASTED	
59	M	582.41		564.65	17.76	FASTED	
60	M	632.81		620.92	11.89	FASTED	
Average Consumption				13.16			

Day		Tuesday		Wednesday			
Date		9/3/2013		9/4/2013			
ID	Group	Food In	Food Out	Food Out	Food Consumed	Food In	Food Out
61	H	650.53	FASTED				
62	H	592	FASTED				
63	H	680.11	FASTED				
64	H	599.9	FASTED				
65	H	606.86	FASTED				
66	H	605.32	FASTED				
135	H	654.11	FASTED				
68	H	629.05	FASTED				
69	H	649.54	FASTED				
70	H	638.12	FASTED				
71	H	588.33		572.15	16.18	FASTED	
72	H	676.06		665.5	10.56	FASTED	
73	H	678.87		660.87	18	FASTED	
74	H	630.32		621.09	9.23	FASTED	
75	H	612.85		594.34	18.51	FASTED	
76	H	636.1		624.01	12.09	FASTED	
77	H	628.5		611.19	17.31	FASTED	
78	H	626.68		615.17	11.51	FASTED	
79	H	616.6		598.83	17.77	FASTED	
80	H	638.99		629.6	9.39	FASTED	
Average Consumption				14.06			

ID = animal id# cation number; C = control; L = 200 mg/m3; M = 700 mg/m3; H = 2000 mg/m3

Ophthalmic Exam Data: Pre-Exposure

Date: 5/14/2013 to 5/15/2013																	
Animal ID	Group	Globe	Eye Lids	Conjunctiva	Lacrimal apparatus	Cornea	Sclera	Anterior chamber	Pupil	Posterior chamber	Ciliary body	Lens	Vitreous body	Retina	Choroid	Optic nerve/disc	Notes
1	Control																Normal both eyes
2	Control																Normal both eyes
3	Control																Normal both eyes
4	Control																Normal both eyes
5	Control																Normal both eyes
6	Control																Normal both eyes
7	Control																Normal both eyes
8	Control																Normal both eyes
109	Control																Normal both eyes
10	Control																Normal both eyes
11	Control																Normal both eyes
12	Control																Normal both eyes
13	Control																Normal both eyes
14	Control																Normal both eyes
15	Control																Normal both eyes
16	Control																Normal both eyes
117	Control																Normal both eyes
18	Control																Normal both eyes
19	Control																Normal both eyes
20	Control																Normal both eyes
21	Low																Normal both eyes
22	Low																Normal both eyes
23	Low																Normal both eyes
24	Low																Normal both eyes
25	Low																Normal both eyes
26	Low																Normal both eyes
27	Low																Normal both eyes
28	Low																Normal both eyes
129	Low																Normal both eyes
30	Low																Normal both eyes
31	Low																Normal both eyes
32	Low																Normal both eyes
33	Low																Normal both eyes
34	Low																Normal both eyes
35	Low																Normal both eyes
36	Low																Normal both eyes
37	Low																Normal both eyes
38	Low																Normal both eyes
39	Low																Normal both eyes
40	Low																Normal both eyes
41	Med																Normal both eyes
42	Med																Normal both eyes
43	Med																Normal both eyes
44	Med																Normal both eyes
45	Med																Normal both eyes
46	Med																Normal both eyes
47	Med																Normal both eyes
48	Med																Normal both eyes
49	Med																Normal both eyes
50	Med																Normal both eyes
51	Med																Normal both eyes
52	Med																Normal both eyes
53	Med																Normal both eyes
54	Med																Normal both eyes
55	Med																Normal both eyes
56	Med																Normal both eyes
57	Med																Normal both eyes
58	Med																Normal both eyes
59	Med																Normal both eyes
60	Med																Normal both eyes

Animal ID	Group	Globe	Eye Lids	Conjunctiva	Lacrimal apparatus	Cornea	Sclera	Anterior chamber	Pupil	Posterior chamber	Ciliary body	Lens	Vitreous body	Retina	Choroid	Optic nerve/disc	Notes
61	High																Normal both eyes
62	High																Normal both eyes
63	High																Normal both eyes
64	High																Normal both eyes
65	High																Normal both eyes
66	High																Normal both eyes
135	High																Normal both eyes
68	High																Normal both eyes
69	High																Normal both eyes
70	High																Normal both eyes
71	High																Normal both eyes
72	High																Normal both eyes
73	High																Normal both eyes
74	High																Normal both eyes
75	High																Normal both eyes
76	High																Normal both eyes
77	High																Normal both eyes
78	High																Normal both eyes
79	High																Normal both eyes
80	High																Normal both eyes

Note: Low = 200 mg/m³ Gevo (bio) ATJ SPK; Med = 700 mg/m³ Gevo (bio) ATJ SPK; High = 2000 mg/m³ Gevo (bio) ATJ SPK

Ophthalmic Exam Data: Week 14

Animal ID	Group	Globe	Eye Lids	Conjunctiva	Lacrimal apparatus	Cornea	Sclera	Anterior chamber	Pupil	Posterior chamber	Ciliary body	Lens	Vitreous body	Retina	Choroid	Optic nerve/disc	Notes
1	Control																No abnormal findings
2	Control																No abnormal findings
3	Control																No abnormal findings
4	Control																No abnormal findings
5	Control																No abnormal findings
6	Control																No abnormal findings
7	Control																No abnormal findings
8	Control																No abnormal findings
109	Control																No abnormal findings
10	Control																No abnormal findings
11	Control																No abnormal findings
12	Control																No abnormal findings
13	Control																No abnormal findings
14	Control																No abnormal findings
15	Control																No abnormal findings
16	Control																No abnormal findings
117	Control																No abnormal findings
18	Control																No abnormal findings
19	Control																No abnormal findings
20	Control		x														Porphyrin left eye
21	Low																No abnormal findings
22	Low																No abnormal findings
23	Low																No abnormal findings
24	Low																No abnormal findings
25	Low																No abnormal findings
26	Low																No abnormal findings
27	Low																No abnormal findings
28	Low																No abnormal findings
129	Low																No abnormal findings
30	Low																No abnormal findings
31	Low																No abnormal findings
32	Low		x														Porphyrin(moderate) left eye
33	Low																No abnormal findings
34	Low																No abnormal findings
35	Low																No abnormal findings
36	Low																No abnormal findings
37	Low																No abnormal findings
38	Low																No abnormal findings
39	Low																No abnormal findings
40	Low																No abnormal findings
41	Med																No abnormal findings
42	Med																No abnormal findings
43	Med																No abnormal findings
44	Med																No abnormal findings
45	Med	x															Right eye exophthalmic
46	Med																No abnormal findings
47	Med																No abnormal findings
48	Med		x														Porphyrin(moderate) right eye
49	Med																No abnormal findings
50	Med																No abnormal findings
51	Med																No abnormal findings
52	Med																No abnormal findings
53	Med		x														Porphyrin(moderate) right eye
54	Med																No abnormal findings
55	Med																No abnormal findings
56	Med																No abnormal findings
57	Med																No abnormal findings
58	Med																No abnormal findings
59	Med																No abnormal findings
60	Med																No abnormal findings

Animal ID	Group	Globe	Eye Lids	Conjunctiva	Lacrimal apparatus	Cornea	Sclera	Anterior chamber	Pupil	Posterior chamber	Ciliary body	Lens	Vitreous body	Retina	Choroid	Optic nerve/disc	Notes
61	High																No abnormal findings
62	High																No abnormal findings
63	High																No abnormal findings
64	High																No abnormal findings
65	High																No abnormal findings
66	High																No abnormal findings
135	High																No abnormal findings
68	High																No abnormal findings
69	High																No abnormal findings
70	High	x	x									x				x	Right eye porphyrin, alopecia, exophthalmic ¹
71	High																No abnormal findings
72	High																No abnormal findings
73	High																No abnormal findings
74	High																No abnormal findings
75	High																No abnormal findings
76	High																No abnormal findings
77	High																No abnormal findings
78	High																No abnormal findings
79	High																No abnormal findings
80	High																No abnormal findings

¹lens opaque hypersensitive to light cannot visualize optic disc

Note: Low = 200 mg/m³ Gevo (bio) ATJ SPK; Med = 700 mg/m³ Gevo (bio) ATJ SPK; High = 2000 mg/m³ Gevo (bio) ATJ SPK

APPENDIX D. NEUROTOXICITY TESTING

Male Rat Motor Activity Data following Exposure to Gevo (bio) ATJ SPK

Session ID	Subject ID	Exposure Group	Total Distance	Actual Distance	Average Speed	Total Resting Time	Actual Resting Time	Activity Time	Total Rears	1st 10 Perimeter BB	1st 10 Center BB	Total BB	% in Center	Fine Total	Ambulatory Total	Chamber
Units:			cm	cm	cm/sec	sec	sec/3600	sec/3600	BB	BB	BB	BB	%	BB	BB	
082213D1R1	1	C	23620.60	2362.06	40.24	18913.00	1891.30	1708.70	74.00	810.00	855.00	1665.00	51.35	355.00	3970.00	1
082213D1R1	21	L	42961.70	4296.17	44.78	14707.00	1470.70	2129.30	154.00	1088.00	1371.00	2459.00	55.75	380.00	7010.00	2
082213D1R1	41	M	24728.70	2472.87	37.86	20855.00	2085.50	1514.50	75.00	945.00	1078.00	2023.00	53.29	400.00	4339.00	3
082213D1R1	61	H	50660.40	5066.04	48.50	15526.00	1552.60	2047.40	105.00	903.00	1429.00	2332.00	61.28	411.00	8312.00	4
082213D1R1	3	C	28174.70	2817.47	37.93	18555.00	1855.50	1744.50	117.00	920.00	861.00	1781.00	48.34	371.00	4930.00	5
082213D1R1	23	L	31404.70	3140.47	39.07	18696.00	1869.60	1730.40	140.00	1272.00	1038.00	2310.00	44.94	372.00	5854.00	6
082213D1R1	43	M	26004.70	2600.47	36.81	18620.00	1862.00	1738.00	90.00	1056.00	1108.00	2164.00	51.20	427.00	4682.00	7
082213D1R1	63	H	26434.60	2643.46	33.08	17115.00	1711.50	1888.50	103.00	433.00	928.00	1361.00	68.19	466.00	5028.00	8
082213D1R2	25	L	30393.00	3039.30	43.55	20406.00	2040.60	1559.40	70.00	878.00	1145.00	2023.00	56.60	450.00	4898.00	1
082213D1R2	45	M	35102.40	3510.24	43.70	18972.00	1897.20	1702.80	192.00	968.00	1600.00	2568.00	62.31	379.00	6354.00	2
082213D1R2	65	H	30712.20	3071.22	39.14	17686.00	1768.60	1831.40	58.00	851.00	924.00	1775.00	52.06	419.00	4612.00	3
082213D1R2	5	C	35663.30	3566.33	43.59	18190.00	1819.00	1781.00	80.00	1480.00	1169.00	2649.00	44.13	480.00	5907.00	4
082213D1R2	27	L	30769.30	3076.93	34.86	14103.00	1410.30	2189.70	97.00	899.00	956.00	1855.00	51.54	457.00	5947.00	5
082213D1R2	47	M	27302.40	2730.24	37.62	19302.00	1930.20	1669.80	69.00	1074.00	931.00	2005.00	46.43	464.00	4701.00	6
082213D1R2	135	H	38388.80	3838.88	37.28	14274.00	1427.40	2172.60	92.00	1064.00	1106.00	2170.00	50.97	409.00	6531.00	7
082213D1R2	7	C	31100.10	3110.01	34.29	15480.00	1548.00	2052.00	115.00	930.00	1051.00	1981.00	53.05	468.00	6088.00	8
082213D1R3	49	M	33358.90	3335.89	42.46	19128.00	1912.80	1687.20	103.00	1194.00	1034.00	2228.00	46.41	366.00	5590.00	1
082213D1R3	69	H	28708.40	2870.84	42.71	21878.00	2187.80	1412.20	80.00	1135.00	1336.00	2471.00	54.07	470.00	4654.00	2
082213D1R3	109	C	44290.80	4429.08	44.14	15085.00	1508.50	2091.50	94.00	1254.00	1155.00	2409.00	47.95	403.00	7428.00	3
082213D1R3	129	L	36392.60	3639.26	41.52	16610.00	1661.00	1939.00	56.00	912.00	955.00	1867.00	51.15	412.00	5938.00	4
082313D2R4	71	H	34794.20	3479.42	45.35	18561.00	1856.10	1743.90	80.00	1434.00	1219.00	2653.00	45.95	345.00	5776.00	1
082313D2R4	11	C	28471.80	2847.18	37.75	18206.00	1820.60	1779.40	79.00	903.00	1112.00	2015.00	55.19	314.00	4675.00	2
082313D2R4	31	L	24810.00	2481.00	45.16	21706.00	2170.60	1429.40	55.00	1030.00	1047.00	2077.00	50.41	388.00	4213.00	3
082313D2R4	51	M	42004.80	4200.48	40.30	13154.00	1315.40	2284.60	106.00	1009.00	1334.00	2343.00	56.94	385.00	6708.00	4
082313D2R4	73	H	39440.40	3944.04	34.91	12434.00	1243.40	2356.60	167.00	1091.00	1320.00	2411.00	54.75	432.00	7287.00	5
082313D2R4	13	C	38122.50	3812.25	40.98	15502.00	1550.20	2049.80	92.00	967.00	1231.00	2198.00	56.01	391.00	6428.00	6
082313D2R4	33	L	35445.40	3544.54	39.92	15773.00	1577.30	2022.70	104.00	1095.00	1027.00	2122.00	48.40	353.00	6104.00	7
082313D2R4	53	M	30778.70	3077.87	31.76	14756.00	1475.60	2124.40	112.00	928.00	1000.00	1928.00	51.87	482.00	6101.00	8
082313D2R5	117	C	38227.50	3822.75	40.79	15178.00	1517.80	2082.20	106.00	1384.00	1085.00	2469.00	43.94	425.00	6545.00	1
082313D2R5	37	L	48837.40	4883.74	41.78	11465.00	1146.50	2453.50	118.00	1060.00	1382.00	2442.00	56.59	413.00	8333.00	2
082313D2R5	57	M	30772.40	3077.24	40.78	17317.00	1731.70	1868.30	111.00	1083.00	1256.00	2339.00	53.70	371.00	5259.00	3
082313D2R5	75	H	40174.90	4017.49	42.83	15123.00	1512.30	2087.70	77.00	1402.00	1142.00	2544.00	44.89	393.00	6412.00	4
082313D2R5	55	M	27956.20	2795.62	34.33	16078.00	1607.80	1992.20	97.00	765.00	847.00	1612.00	52.54	403.00	5230.00	5
082313D2R5	77	H	36189.90	3618.99	37.15	12738.00	1273.80	2326.20	92.00	824.00	868.00	1692.00	51.30	469.00	5948.00	6
082313D2R5	15	C	30602.90	3060.29	36.17	16752.00	1675.20	1924.80	72.00	1014.00	956.00	1970.00	48.53	330.00	5291.00	7
082313D2R5	35	L	26039.50	2603.95	31.86	15166.00	1516.60	2083.40	92.00	1091.00	991.00	2082.00	47.60	358.00	4953.00	8
082313D2R6	19	C	23222.20	2322.22	34.24	18943.00	1894.30	1705.70	70.00	1055.00	1028.00	2083.00	49.35	347.00	4486.00	5
082313D2R6	39	L	37712.00	3771.20	40.64	16712.00	1671.20	1928.80	122.00	1425.00	946.00	2371.00	39.90	379.00	6255.00	6
082313D2R6	59	M	36312.30	3631.23	37.32	14575.00	1457.50	2142.50	69.00	1595.00	952.00	2547.00	37.38	387.00	6263.00	7
082313D2R6	79	H	33614.20	3361.42	34.85	14959.00	1495.90	2104.10	174.00	983.00	1119.00	2102.00	53.24	440.00	6256.00	8

BB = beam breaks; C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3; sec = seconds

Resting time metric = 4 seconds; Perimeter settings: X = 4 and Y = 4

Female Rat Motor Activity Data following Exposure to Gevo (bio) ATJ SPK

Session ID	Subject ID	Exposure Group	Total Distance	Actual Distance	Average Speed	Total Resting Time	Actual Resting Time	Activity Time	Total Rears	1st 10 Perimeter BB	1st 10 Center BB	Total BB	% in Center	Fine Total	Ambulatory Total	Chamber
Units:			cm	cm	cm/sec	sec	sec/3600	sec/3600	BB	BB	BB	BB	%	BB	BB	
082213D1R4	2	C	31231.60	3123.16	38.48	18512.00	1851.20	1748.80	92.00	950.00	1058.00	2008.00	52.69	441.00	5723.00	1
082213D1R4	22	L	18548.80	1854.88	34.08	22973.00	2297.30	1302.70	93.00	1014.00	740.00	1754.00	42.19	450.00	3752.00	2
082213D1R4	42	M	20448.10	2044.81	35.38	14101.00	1410.10	2189.90	67.00	1056.00	826.00	1882.00	43.89	393.00	4018.00	3
082213D1R4	62	H	36555.40	3655.54	38.92	11935.00	1193.50	2406.50	121.00	1432.00	1079.00	2511.00	42.97	403.00	7092.00	4
082213D1R4	4	C	23294.90	2329.49	29.02	17763.00	1776.30	1823.70	98.00	1097.00	818.00	1915.00	42.72	479.00	4809.00	5
082213D1R4	24	L	34794.30	3479.43	34.45	13954.00	1395.40	2204.60	158.00	1544.00	743.00	2287.00	32.49	459.00	7101.00	6
082213D1R4	44	M	32770.00	3277.00	36.35	17291.00	1729.10	1870.90	89.00	1371.00	1045.00	2416.00	43.25	397.00	6339.00	7
082213D1R4	64	H	23705.90	2370.59	26.19	14046.00	1404.60	2195.40	142.00	1035.00	749.00	1784.00	41.98	507.00	5180.00	8
082213D1R5	26	L	38559.50	3855.95	44.29	18023.00	1802.30	1797.70	79.00	1363.00	1167.00	2530.00	46.13	343.00	6716.00	1
082213D1R5	46	M	26435.10	2643.51	40.83	22287.00	2228.70	1371.30	118.00	1091.00	1020.00	2111.00	48.32	386.00	5193.00	2
082213D1R5	66	H	34884.00	3488.40	38.78	14273.00	1427.30	2172.70	120.00	1458.00	1179.00	2637.00	44.71	417.00	6708.00	3
082213D1R5	6	C	38690.90	3869.09	38.04	14520.00	1452.00	2148.00	108.00	1262.00	1185.00	2447.00	48.43	497.00	7222.00	4
082213D1R5	28	L	30338.10	3033.81	33.27	15540.00	1554.00	2046.00	189.00	1498.00	911.00	2409.00	37.82	505.00	6389.00	5
082213D1R5	48	M	27412.60	2741.26	34.11	17596.00	1759.60	1840.40	80.00	1423.00	947.00	2370.00	39.96	359.00	5537.00	6
082213D1R5	68	H	31479.60	3147.96	30.32	12308.00	1230.80	2369.20	129.00	1228.00	803.00	2031.00	39.54	508.00	6514.00	7
082213D1R5	8	C	22643.10	2264.31	28.93	17182.00	1718.20	1881.80	128.00	1131.00	708.00	1839.00	38.50	391.00	5011.00	8
082213D1R6	50	M	46561.70	4656.17	40.90	12134.00	1213.40	2386.60	178.00	1357.00	916.00	2273.00	40.30	518.00	8662.00	1
082213D1R6	70	H	32638.20	3263.82	39.97	18268.00	1826.80	1773.20	132.00	1212.00	1481.00	2693.00	54.99	484.00	6184.00	2
082213D1R6	10	C	38148.50	3814.85	41.92	16629.00	1662.90	1937.10	127.00	1558.00	1447.00	3005.00	48.15	447.00	7231.00	3
082213D1R6	30	L	24682.70	2468.27	37.77	21529.00	2152.90	1447.10	86.00	1258.00	807.00	2065.00	39.08	304.00	4646.00	4
082313D2R1	72	H	47492.10	4749.21	38.95	13271.00	1327.10	2272.90	193.00	1161.00	1281.00	2442.00	52.46	413.00	9676.00	1
082313D2R1	12	C	23860.00	2386.00	36.63	19955.00	1995.50	1604.50	75.00	1047.00	1113.00	2160.00	51.53	409.00	4642.00	2
082313D2R1	32	L	32403.70	3240.37	37.89	17189.00	1718.90	1881.10	141.00	1360.00	1256.00	2616.00	48.01	362.00	6216.00	3
082313D2R1	52	M	33109.40	3310.94	38.86	18265.00	1826.50	1773.50	87.00	1134.00	632.00	1766.00	35.79	382.00	6211.00	4
082313D2R1	74	H	31351.20	3135.12	33.13	14491.00	1449.10	2150.90	181.00	1049.00	1026.00	2075.00	49.45	440.00	6522.00	5
082313D2R1	14	C	32168.70	3216.87	35.36	15459.00	1545.90	2054.10	142.00	1373.00	722.00	2095.00	34.46	496.00	6401.00	6
082313D2R1	34	L	25869.80	2586.98	29.78	16209.00	1620.90	1979.10	131.00	1053.00	705.00	1758.00	40.10	504.00	5519.00	7
082313D2R1	54	M	21490.80	2149.08	30.02	16979.00	1697.90	1902.10	96.00	1282.00	634.00	1916.00	33.09	470.00	4687.00	8
082313D2R2	18	C	35951.60	3595.16	39.04	16413.00	1641.30	1958.70	129.00	1190.00	1142.00	2332.00	48.97	466.00	6799.00	1
082313D2R2	38	L	25191.00	2519.10	36.26	20034.00	2003.40	1596.60	117.00	915.00	911.00	1826.00	49.89	445.00	5148.00	2
082313D2R2	58	M	26216.00	2621.60	38.57	19307.00	1930.70	1669.30	91.00	1248.00	686.00	1934.00	35.47	503.00	4966.00	3
082313D2R2	76	H	45986.40	4598.64	37.21	10563.00	1056.30	2543.70	160.00	1514.00	1004.00	2518.00	39.87	406.00	8966.00	4
082313D2R2	56	M	32680.60	3268.06	32.15	13371.00	1337.10	2262.90	193.00	1114.00	660.00	1774.00	37.20	598.00	6353.00	5
082313D2R2	78	H	32620.10	3262.01	34.79	15742.00	1574.20	2025.80	138.00	1332.00	930.00	2262.00	41.11	426.00	6571.00	6
082313D2R2	16	C	21777.40	2177.74	31.19	19826.00	1982.60	1617.40	96.00	1145.00	723.00	1868.00	38.70	411.00	4562.00	7
082313D2R2	36	L	18479.30	1847.93	29.84	20652.00	2065.20	1534.80	95.00	1120.00	454.00	1574.00	28.84	491.00	4161.00	8
082313D2R3	20	C	17931.30	1793.13	30.15	20947.00	2094.70	1505.30	102.00	1412.00	585.00	1997.00	29.29	446.00	3972.00	5
082313D2R3	40	L	28376.30	2837.63	35.58	17168.00	1716.80	1883.20	103.00	1209.00	919.00	2128.00	43.19	416.00	5486.00	6
082313D2R3	60	M	25018.50	2501.85	32.89	14285.00	1428.50	2171.50	96.00	1369.00	760.00	2129.00	35.70	498.00	5030.00	7
082313D2R3	80	H	25982.20	2598.22	29.53	11880.00	1188.00	2412.00	141.00	1282.00	778.00	2060.00	37.77	441.00	5658.00	8
BB = beam breaks; C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3; sec = seconds																
Resting time metric = 4 seconds; Perimeter settings: X = 4 and Y = 4																

**Male Rat FOB Data following Exposure to Gevo (bio) ATJ SPK:
Cage Side Observations**

Cage side Observations												
Date	8/29/2013-8/30/13											
Animal ID	Exposure Group	Observation Time	Posture	Tremor	Severity	Induction	Spasm	Location	Seizures	Clonic Convulsions	Seizure Severity	Palpebral closure
1	C	850	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
21	L	904	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
41	M	918	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
61	H	924	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
3	C	930	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
23	L	945	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
43	M	947	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
63	H	950	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
5	C	955	1	0	N/A	N/A	0	N/A	0	N/A	N/A	2
25	L	958	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
45	M	1007	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
65	H	1011	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
7	C	1016	2	0	N/A	N/A	0	N/A	0	N/A	N/A	3
27	L	1020	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
47	M	1031	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
135	H	1035	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
109	C	1039	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
129	L	1043	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
49	M	1046	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
69	H	1049	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
11	C	1119	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
31	L	1122	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
51	M	1125	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
71	H	1127	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
13	C	1130	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
33	L	1134	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
53	M	1138	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
73	H	1141	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
15	C	1144	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
35	L	1148	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
55	M	1151	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
75	H	1154	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
117	C	1158	2	0	N/A	N/A	0	N/A	0	N/A	N/A	2
37	L	1202	2	0	N/A	N/A	0	N/A	0	N/A	N/A	2
57	M	1206	1	0	N/A	N/A	0	N/A	0	N/A	N/A	2
77	H	1211	1	0	N/A	N/A	0	N/A	0	N/A	N/A	2
19	C	1215	1	0	N/A	N/A	0	N/A	0	N/A	N/A	2
39	L	1219	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
59	M	1223	2	0	N/A	N/A	0	N/A	0	N/A	N/A	3
79	H	1226	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3												

Cage side Observations											
Date											
Animal ID	Removal time	Handling Reactivity	Piloerection	Muscle Tone	Lacrimation	Salivation	Fur Appearance	Facial Crust	Skin	Breathing Pattern	Additional Observations
1	851	1	0	1	0	0	1	1	1	1	0
21	905	1	0	1	0	0	1	0	1	1	0
41	919	1	0	1	0	0	1	0	1	1	0
61	928	1	0	1	0	0	1	0	1	1	0
3	931	1	0	1	0	0	1	0	1	1	0
23	946	1	0	1	0	0	1	0	1	1	0
43	948	1	0	1	0	0	1	0	1	1	0
63	951	1	0	1	0	0	1	0	1	1	0
5	956	1	0	1	0	0	1	0	1	1	0
25	959	1	0	1	0	0	1	0	1	1	0
45	1008	1	0	1	0	0	1	0	1	1	0
65	1012	1	0	1	0	0	1	0	1	1	0
7	1017	1	0	1	0	0	1	0	1	1	0
27	1022	1	0	1	0	0	1	1	1	1	0
47	1032	1	0	1	0	0	1	0	1	1	0
135	1036	1	0	1	0	0	1	0	1	1	0
109	1040	1	0	1	0	0	1	0	1	1	0
129	1044	1	0	1	0	0	1	0	1	1	0
49	1047	1	0	1	0	0	1	0	1	1	0
69	1050	1	0	1	0	0	1	0	1	1	0
11	1120	1	0	1	0	0	1	0	1	1	0
31	1123	1	0	1	0	0	1	0	1	1	0
51	1126	1	0	1	0	0	1	0	1	1	0
71	1128	1	0	1	0	0	1	0	1	1	0
13	1131	1	0	1	0	0	1	0	1	1	0
33	1135	1	0	1	0	0	1	0	1	1	0
53	1139	1	0	1	0	0	1	0	1	1	0
73	1142	1	0	1	0	0	1	0	1	1	0
15	1145	1	0	1	0	0	1	0	1	1	0
35	1149	1	0	1	0	0	1	0	1	1	0
55	1152	1	0	1	0	0	1	0	1	1	0
75	1155	1	0	1	0	0	1	0	1	1	0
117	1159	1	0	1	0	0	1	0	1	1	0
37	1205	1	0	1	0	0	1	0	1	1	0
57	1209	1	0	1	0	0	1	0	1	1	0
77	1213	1	0	1	0	0	1	0	1	1	0
19	1216	1	0	1	0	0	1	0	1	1	0
39	1220	1	0	1	0	0	1	0	1	1	0
59	1224	1	0	1	0	0	1	0	1	1	0
79	1227	1	0	1	0	0	1	0	1	1	0
C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3											

Male Rat FOB Data following Exposure to Gevo (bio) ATJ SPK: Open Field Observations

Open Field Observations																			
Date	8/29/2013-8/30/13																		
Animal ID	Exposure Group	Time	Arousal	Activity	Ataxia	Gait	Body Position	Unusual Behaviors	Tremor	Severity	Induction	Spasm	Location	Seizures	Clonic Convulsions	Seizure Severity	Palpebral Closure	Pupil Reflex	Comments
1	C	852	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
21	L	905	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
41	M	919	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
61	H	925	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
3	C	932	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
23	L	945	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
43	M	949	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
63	H	954	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
5	C	958	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
25	L	1007	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
45	M	1012	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
65	H	1015	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
7	C	1018	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
27	L	1022	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
47	M	1034	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
135	H	1038	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
109	C	1041	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
129	L	1045	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
49	M	1048	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
69	H	1052	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
11	C	1120	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
31	L	1123	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
51	M	1126	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
71	H	1130	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
13	C	1134	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
33	L	1139	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
53	M	1140	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
73	H	1143	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
15	C	1146	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
35	L	1150	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
55	M	1154	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
75	H	1157	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
117	C	1201	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
37	L	1206	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
57	M	1211	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
77	H	1214	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
19	C	1218	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
39	L	1221	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
59	M	1225	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
79	H	1228	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	

C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3

Male Rat FOB Data following Exposure to Gevo (bio) ATJ SPK: Manipulative Observations

Manipulative Observations																					
Date 8/29/2013-8/30/13				Quantitative Data																	
Animal	Exposure	Approach	Acoustic	Tail	Fecal	Appearance	Urine	Rears	Grooming	Visual	Surface	Forelimb	Grip	FGS	Hindlimb	HGS	Hindlimb	Splay	Splay		
ID	Group	Response	Response	Pinch	Boli #		pools			Placing	Righting	Strength		Average	Grip Strength	Average			Average	Comments	
1	C	1	1	1	N/A		0	3	15	4	1	1	0.51	0.62	0.56	0.10	0.16	0.13	85.00	65.00	75.00
21	L	1	1	1	N/A		0	5	13	4	1	1	0.23	0.22	0.23	0.08	0.09	0.08	58.00	60.00	59.00
41	M	1	1	1	N/A		0	2	16	4	1	1	0.34	0.29	0.31	0.09	0.08	0.08	65.00	97.00	81.00
61	H	1	1	1	N/A		0	0	14	4	1	1	0.35	0.33	0.34	0.14	0.13	0.13	87.00	85.00	86.00
3	C	1	1	1	N/A		0	0	18	3	1	1	0.35	0.29	0.32	0.15	0.09	0.12	70.00	68.00	69.00
23	L	1	1	1	N/A		0	1	14	2	1	1	0.31	0.25	0.28	0.09	0.11	0.10	75.00	95.00	85.00
43	M	1	1	1	N/A		0	0	10	2	1	1	0.31	0.26	0.28	0.14	0.12	0.13	125.00	100.00	112.50
63	H	1	1	1	N/A		0	0	18	4	1	1	0.37	0.36	0.36	0.16	0.14	0.15	35.00	70.00	52.50
5	C	1	1	1	N/A		0	0	10	3	1	1	0.32	0.33	0.32	0.13	0.15	0.14	100.00	68.00	84.00
25	L	1	1	1	N/A		0	0	26	1	1	1	0.29	0.29	0.29	0.10	0.13	0.11	70.00	28.00	49.00
45	M	1	1	1	N/A		0	0	18	3	1	1	0.35	0.43	0.39	0.12	0.17	0.15	120.00	58.00	89.00
65	H	1	1	1	N/A		0	0	13	4	1	1	0.30	0.38	0.34	0.14	0.08	0.11	90.00	109.00	99.50
7	C	1	1	1	N/A		0	0	5	1	1	1	0.38	0.20	0.29	0.11	0.12	0.11	90.00	50.00	70.00
27	L	1	1	1	N/A		0	0	9	4	1	1	0.20	0.20	0.20	0.09	0.07	0.08	83.00	90.00	86.50
47	M	1	1	1	N/A		0	0	15	6	1	1	0.58	0.28	0.43	0.17	0.17	0.17	80.00	90.00	85.00
135	H	1	1	1	N/A		0	0	12	3	1	1	0.47	0.25	0.36	0.12	0.15	0.13	75.00	85.00	80.00
109	C	1	1	1	N/A		0	0	14	2	1	1	0.42	0.54	0.48	0.13	0.12	0.12	40.00	64.00	52.00
129	L	1	1	1	N/A		0	0	14	3	1	1	0.51	0.32	0.41	0.11	0.15	0.13	60.00	75.00	67.50
49	M	1	1	1	N/A		0	0	17	4	1	1	0.53	0.33	0.43	0.14	0.10	0.12	92.00	50.00	71.00
69	H	1	1	1	N/A		0	0	16	1	1	1	0.36	0.39	0.38	0.13	0.13	0.13	55.00	98.00	76.50
11	C	1	1	1	N/A		0	4	11	1	1	1	0.63	0.43	0.53	0.16	0.07	0.12	110.00	85.00	97.50
31	L	1	1	1	N/A		0	0	19	1	1	1	0.50	0.37	0.44	0.14	0.10	0.12	94.00	115.00	104.50
51	M	1	1	1	N/A		0	3	7	1	1	1	0.37	0.45	0.41	0.13	0.08	0.10	115.00	65.00	90.00
71	H	1	1	1	N/A		0	0	17	2	1	1	0.61	0.32	0.46	0.07	0.13	0.10	115.00	140.00	127.50
13	C	1	1	1	N/A		0	0	19	3	1	1	0.29	0.34	0.31	0.10	0.09	0.09	64.00	86.00	75.00
33	L	1	1	1	N/A		0	0	14	6	1	1	0.61	0.39	0.50	0.07	0.10	0.08	78.00	84.00	81.00
53	M	1	1	1	N/A		0	0	16	1	1	1	0.31	0.43	0.37	0.10	0.11	0.11	92.00	147.00	119.50
73	H	1	1	1	N/A		0	0	11	3	1	1	0.44	0.55	0.50	0.08	0.06	0.07	95.00	87.00	91.00
15	C	1	1	1	N/A		0	0	8	6	1	1	0.60	0.43	0.51	0.19	0.09	0.14	73.00	115.00	94.00
35	L	1	1	1	N/A		0	0	10	4	1	1	0.64	0.44	0.54	0.16	0.12	0.14	58.00	122.00	90.00
55	M	1	1	1	N/A		0	0	9	4	1	1	0.59	0.62	0.61	0.17	0.15	0.16	123.00	95.00	109.00
75	H	1	1	1	N/A		0	0	12	2	1	1	0.60	0.37	0.48	0.11	0.05	0.08	114.00	90.00	102.00
117	C	1	1	1	N/A		0	0	14	2	1	1	0.32	0.17	0.24	0.10	0.08	0.09	117.00	115.00	116.00
37	L	1	1	1	N/A		0	0	12	2	1	1	0.30	0.14	0.22	0.08	0.07	0.07	114.00	133.00	123.50
57	M	1	1	1	N/A		0	1	6	1	1	1	0.32	0.15	0.24	0.10	0.11	0.10	67.00	68.00	67.50
77	H	1	1	1	N/A		0	0	7	3	1	1	0.41	0.25	0.33	0.07	0.08	0.07	50.00	54.00	52.00
19	C	1	1	1	N/A		0	1	8	2	1	1	0.59	0.51	0.55	0.12	0.05	0.08	63.00	54.00	58.50
39	L	1	1	1	N/A		0	0	10	2	1	1	0.515	0.325	0.42	0.12	0.09	0.10	91.00	127.00	109.00
59	M	1	1	1	N/A		0	0	15	3	1	1	0.39	0.22	0.31	0.17	0.09	0.13	76.00	114.00	95.00
79	H	1	1	1	N/A		0	1	11	3	1	1	0.45	0.565	0.51	0.12	0.12	0.12	95.00	80.00	87.50

C = control; FGS = forelimb grip strength; H = 2000 mg/m3; HGS = hindlimb grip strength; ID = identification; L = 200 mg/m3; M = 700 mg/m3

C = control; FGS = forelimb grip strength; H = 2000 mg/m3; HGS = hindlimb grip strength; ID = identification; L = 200 mg/m3; M = 700 mg/m3

**Female Rat FOB Data following Exposure to Gevo (bio) ATJ SPK:
Cage Side Observations**

Cage side Observations												
Date		08/29/2013-08/30/13										
Animal ID	Exposure Group	Observation Time	Posture	Tremor	Severity	Induction	Spasm	Location	Seizures	Clonic Convulsions	Seizure Severity	Palpebral closure
2	C	1227	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
22	L	1230	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
42	M	1232	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
62	H	1235	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
4	C	1240	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
24	L	1244	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
44	M	1250	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
64	H	1256	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
6	C	1302	2	0	N/A	N/A	0	N/A	0	N/A	N/A	2
26	L	1309	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
46	M	1311	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
66	H	1315	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
8	C	1319	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
28	L	1323	2	0	N/A	N/A	0	N/A	0	N/A	N/A	3
48	M	1326	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
68	H	1330	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
10	C	1333	2	0	N/A	N/A	0	N/A	0	N/A	N/A	3
30	L	1337	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
50	M	1340	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
70	H	1344	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
12	C	844	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
32	L	847	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
52	M	850	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
72	H	854	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
14	C	858	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
34	L	902	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
54	M	906	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
74	H	910	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
16	C	914	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
36	L	917	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
56	M	920	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
76	H	925	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
18	C	928	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
38	L	930	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
58	M	938	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
78	H	937	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
20	C	940	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
40	L	944	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
60	M	946	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
80	H	949	1	0	N/A	N/A	0	N/A	0	N/A	N/A	1
C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3												

Cage side Observations												
Date												
Animal ID	Removal time	Handling Reactivity	Piloerection	Muscle Tone	Lacrimation	Salivation	Fur Appearance	Facial Crust	Skin	Breathing Pattern	Additional Observations	Comments
2	1228	1	0	1	0	0	1	0	1	1	0	
22	1231	1	0	1	0	0	1	1	1	1	0	R EYE
42	1233	1	0	1	0	0	1	0	1	1	0	
62	1236	1	0	1	0	0	3	0	1	1	0	URINE
4	1241	1	0	1	0	0	1	0	1	1	0	
24	1245	1	0	1	0	0	1	0	1	1	0	
44	1250	1	0	1	0	0	1	0	1	1	0	
64	1257	1	0	1	0	0	3	0	1	1	0	URINE
6	1303	1	0	1	0	0	1	2	1	1	0	BOTH
26	1310	1	0	1	0	0	1	0	1	1	0	
46	1312	1	0	1	0	0	1	0	1	1	0	
66	1316	1	0	1	0	0	3	0	1	1	0	URINE
8	1320	1	0	1	0	0	1	0	1	1	0	
28	1324	1	0	1	0	0	1	0	1	1	0	
48	1327	1	0	1	0	0	1	0	1	1	0	
68	1331	1	0	1	0	0	1	0	1	1	0	
10	1334	1	0	1	0	0	1	0	1	1	0	
30	1338	1	0	1	0	0	1	1	1	1	0	R EYE
50	1341	1	0	1	0	0	1	0	1	1	0	
70	1345	1	0	1	0	0	1	0	1	1	0	
12	845	1	0	1	0	0	1	1	1	1	0	L EYE
32	848	1	0	1	0	0	1	1	1	1	0	L EYE
52	851	1	0	1	0	0	1	2	1	1	0	BOTH
72	855	1	0	1	0	0	1	0	1	1	0	
14	859	1	0	1	0	0	1	0	1	1	0	
34	903	1	0	1	0	0	1	0	1	1	0	
54	907	1	0	1	0	0	1	0	1	1	0	
74	911	1	0	1	0	0	3	0	1	1	0	URINE
16	915	1	0	1	0	0	1	0	1	1	0	
36	918	1	0	1	0	0	1	0	1	1	0	
56	921	1	0	1	0	0	1	0	1	1	0	
76	926	1	0	1	0	0	1	0	1	1	0	
18	929	1	0	1	0	0	1	0	1	1	0	
38	931	1	0	1	0	0	1	0	1	1	0	
58	939	1	0	1	0	0	3	1	1	1	0	URINE, R EYE
78	938	1	0	1	0	0	1	0	1	1	0	
20	941	1	0	1	0	0	1	2	1	1	0	BOTH
40	945	1	0	1	0	0	1	1	1	1	0	L EYE
60	947	1	0	1	0	0	1	0	1	1	0	
80	950	1	0	1	0	0	1	0	1	1	0	
C = control; H = 2000 mg/m3; ID = identification; L = 200mg/m3; M = 700mg/m3												

Female Rat FOB Data following Exposure to Gevo (bio) ATJ SPK: Open Field Observations

Open Field Observations																			
Date	08/29/2013-08/30/13																		
Animal ID	Exposure Group	Time	Arousal	Activity	Ataxia	Gait	Body Position	Unusual Behaviors	Tremor	Severity	Induction	Spasm	Location	Seizures	Clonic Convulsions	Seizure Severity	Palpebral Closure	Pupil Reflex	Comments
2	C	1229	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
22	L	1232	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
42	M	1235	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
62	H	1239	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
4	C	1242	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
24	L	1246	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
44	M	1253	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
64	H	1258	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
6	C	1304	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
26	L	1311	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
46	M	1314	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
66	H	1317	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
8	C	1321	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
28	L	1325	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
48	M	1328	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
68	H	1332	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
10	C	1336	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
30	L	1340	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
50	M	1343	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
70	H	1347	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
12	C	846	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
32	L	849	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
52	M	853	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
72	H	858	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
14	C	902	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
34	L	906	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
54	M	909	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
74	H	913	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
16	C	916	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
36	L	918	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
56	M	922	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
76	H	926	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
18	C	929	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
38	L	932	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
58	M	935	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
78	H	938	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
20	C	942	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
40	L	945	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
60	M	949	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
80	H	952	1	1	0	1	1	0	0	N/A	N/A	0	N/A	0	N/A	N/A	1	1	
C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3																			

C = control; H = 2000 mg/m3; ID = identification; L = 200 mg/m3; M = 700 mg/m3

Female Rat FOB Data following Exposure to Gevo (bio) ATJ SPK: Manipulative Observations

Manipulative Observations																				
Date	08/29/2013-08/30/13			Quantitative Data																
Animal	Exposure	Approach	Acoustic	Tail	Fecal	Appearance	Urine	Rears	Grooming	Visual	Surface	Forelimb	FGS	Hindlimb	HGS	Hindlimb	Splay			
ID	Group	Response	Response	Pinch	Boli #		pools			Placing	Righting	GripStrength	Average	GripStrength	Average	Splay	Average	Comments		
2	C	1	1	1	N/A	0	0	16	3	1	1	0.27	0.22	0.24	0.06	0.07	0.06	83	85	84.00
22	L	1	1	1	N/A	0	0	11	3	1	1	0.24	0.24	0.24	0.12	0.08	0.10	75	50	62.50
42	M	1	1	1	N/A	0	0	18	3	1	1	0.29	0.25	0.27	0.11	0.09	0.10	83	83	83.00
62	H	1	1	1	N/A	0	0	15	4	1	1	0.27	0.35	0.31	0.15	0.14	0.15	40	42	41.00
4	C	1	1	1	N/A	0	0	13	2	1	1	0.41	0.37	0.39	0.09	0.08	0.09	95	70	82.50
24	L	1	1	1	N/A	0	0	14	4	1	1	0.25	0.25	0.25	0.10	0.10	0.10	34	74	54.00
44	M	1	1	1	N/A	0	0	22	4	1	1	0.24	0.26	0.25	0.10	0.10	0.10	65	40	52.50
64	H	1	1	1	N/A	0	0	9	5	1	1	0.18	0.14	0.16	0.04	0.06	0.05	100	80	90.00
6	C	1	1	1	N/A	0	0	15	2	1	1	0.18	0.13	0.16	0.05	0.08	0.07	75	68	71.50
26	L	1	1	1	N/A	0	0	15	5	1	1	0.32	0.14	0.23	0.08	0.16	0.12	64	57	60.50
46	M	1	1	1	N/A	0	0	22	5	1	1	0.18	0.17	0.18	0.09	0.12	0.11	72	76	74.00
66	H	1	1	1	N/A	0	0	13	5	1	1	0.55	0.13	0.34	0.07	0.10	0.09	48	64	56.00
8	C	1	1	1	N/A	0	0	14	2	1	1	0.31	0.42	0.36	0.06	0.08	0.07	57	43	50.00
28	L	1	1	1	N/A	0	0	14	3	1	1	0.17	0.21	0.19	0.13	0.14	0.13	53	45	49.00
48	M	1	1	1	N/A	0	0	11	3	1	1	0.47	0.19	0.33	0.08	0.10	0.09	40	50	45.00
68	H	1	1	1	N/A	0	0	17	3	1	1	0.20	0.17	0.19	0.06	0.10	0.08	55	79	67.00
10	C	1	1	1	N/A	0	0	14	2	1	1	0.32	0.42	0.37	0.06	0.05	0.05	54	43	48.50
30	L	1	1	1	N/A	0	0	11	3	1	1	0.33	0.51	0.42	0.07	0.13	0.10	58	53	55.50
50	M	1	1	1	N/A	0	0	18	3	1	1	0.54	0.28	0.41	0.03	0.05	0.04	45	50	47.50
70	H	1	1	1	N/A	0	0	15	4	1	1	0.32	0.23	0.27	0.06	0.10	0.08	73	44	58.50
12	C	1	1	1	N/A	0	0	17	5	1	1	0.40	0.21	0.30	0.06	0.07	0.07	58	73	65.50
32	L	1	1	1	N/A	0	0	18	4	1	1	0.25	0.22	0.23	0.04	0.08	0.06	53	97	75.00
52	M	1	1	1	N/A	0	0	15	3	1	1	0.30	0.48	0.39	0.07	0.13	0.10	87	77	82.00
72	H	1	1	1	N/A	0	0	24	4	1	1	0.27	0.35	0.31	0.09	0.08	0.09	63	83	73.00
14	C	1	1	1	N/A	0	0	19	5	1	1	0.31	0.42	0.36	0.09	0.04	0.06	68	43	55.50
34	L	1	1	1	N/A	0	0	18	5	1	1	0.37	0.27	0.32	0.04	0.09	0.07	67	54	60.50
54	M	1	1	1	N/A	0	0	15	3	1	1	0.22	0.23	0.22	0.05	0.20	0.12	44	37	40.50
74	H	1	1	1	N/A	0	0	15	4	1	1	0.34	0.13	0.23	0.11	0.08	0.09	33	30	31.50
16	C	1	1	1	N/A	0	0	17	3	1	1	0.15	0.19	0.17	0.11	0.06	0.08	63	50	56.50
36	L	1	1	1	N/A	0	0	10	4	1	1	0.22	0.33	0.27	0.09	0.05	0.07	57	85	71.00
56	M	1	1	1	N/A	0	0	18	7	1	1	0.34	0.14	0.24	0.08	0.08	0.08	43	43	43.00
76	H	1	1	1	N/A	0	0	15	6	1	1	0.29	0.29	0.29	0.10	0.09	0.09	74	63	68.50
18	C	1	1	1	N/A	0	0	20	3	1	1	0.34	0.22	0.28	0.08	0.08	0.08	30	60	45.00
38	L	1	1	1	N/A	0	0	16	3	1	1	0.35	0.26	0.31	0.03	0.06	0.04	60	63	61.50
58	M	1	1	1	N/A	0	0	9	6	1	1	0.28	0.49	0.38	0.05	0.09	0.07	60	28	44.00
78	H	1	1	1	N/A	0	0	14	2	1	1	0.19	0.39	0.29	0.05	0.09	0.07	34	55	44.50
20	C	1	1	1	N/A	0	0	15	5	1	1	0.30	0.19	0.24	0.13	0.08	0.11	63	37	50.00
40	L	1	1	1	N/A	0	0	19	3	1	1	0.18	0.21	0.19	0.03	0.05	0.04	65	68	66.50
60	M	1	1	1	N/A	0	0	14	3	1	1	0.61	0.24	0.42	0.07	0.05	0.06	55	60	57.50
80	H	1	1	1	N/A	0	0	17	2	1	1	0.42	0.32	0.37	0.13	0.09	0.11	53	60	56.50
C = control; FGS = forelimb grip strength; H = 2000 mg/m3; HGS = hindlimb grip strength; ID = identification; L = 200 mg/m3; M = 700 mg/m3																				

C = control; FGS = forelimb grip strength; H = 2000 mg/m3; HGS = hindlimb grip strength; ID = identification; L = 200 mg/m3; M = 700 mg/m3

APPENDIX E. VAGINAL CYTOLOGY TO IDENTIFY ESTROUS CYCLICITY

Animal ID	Exposure Group	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	Normal/ Abnormal	# Days in E	% Days in E	# Days in M/D	% Days in M/D
2	control	P/E	E	M	P/E	M	E	E	N	3	0.429	2	0.286
4	control	P/E	P/E	D	D	E	E	E	A	3	0.429	2	0.286
6	control	E	M	P/E	M	P/E	E	P	N	2	0.286	2	0.286
8	control	E	E	M	P/E	E	P	E	N	4	0.571	1	0.143
10	control	D	P/E	E	P	M	E	E	N	3	0.429	2	0.286
12	control	E	M	D/P	E	E	M	P	N	3	0.429	2	0.286
14	control	P	M	E	E	P	E	D	N	3	0.429	2	0.286
16	control	P/E	M	E	E	E	P/E	D/P	A	3	0.429	1	0.143
18	control	P	P/E	D	P/E	D	P	P/E	N	0	0.000	2	0.286
20	control	P/E	E	E	E	E	E	E	A	6	0.857	0	0.000
22	200	M	E	P/E	M	P/E	E	P	N	2	0.286	2	0.286
24	200	E	P/E	P	M	E	M	E	N	3	0.429	2	0.286
26	200	P	P	E	M	E	E	M	N	3	0.429	2	0.286
28	200	E	E	E	P/E	P/E	M	E	A	4	0.571	1	0.143
30	200	E	E	E	E	E	E	P	A	6	0.857	0	0.000
32	200	P/E	E	P	E	M	P/E	E	N	3	0.429	1	0.143
34	200	D	D/P	E	D	P/E	P/E	E	N	2	0.286	2	0.286
36	200	E	E	P	E	E	E	P/E	A	5	0.714	0	0.000
38	200	P/E	P/E	M	E	E	D	E	N	3	0.429	2	0.286
40	200	E	P	P/E	E	M	P/E	P/E	N	2	0.286	1	0.143
42	700	P	E	M	P/E	E	D	E	N	3	0.429	2	0.286
44	700	P	E	M	D/P	E	D	E	N	3	0.429	2	0.286
46	700	E	M	P/E	P/E	E	E	P	N	3	0.429	1	0.143
48	700	P	P/E	M	D/P	E	P	M	N	1	0.143	2	0.286
50	700	E	M	P/E	E	P	M	E	N	3	0.429	2	0.286
52	700	P	P/E	E	P	E	D	P/E	N	2	0.286	1	0.143
54	700	P	E	E	E	E	P	D/P	A	4	0.571	0	0.000
56	700	E	P	E	E	E	E	M	A	5	0.714	1	0.143
58	700	E	E	E	E	E	E	M	A	6	0.857	1	0.143
60	700	E	E	M	E	M	E	E	N	5	0.714	2	0.286
62	2000	P	P/E	P/E	E	D	D/P	M	N	1	0.143	2	0.286
64	2000	P/E	E	P/E	P/E	E	M	P/E	N	2	0.286	1	0.143
66	2000	E	P	P	P/E	E	E	P/E	N	3	0.429	0	0.000
68	2000	E	E	E	P/E	P/E	E	E	A	2	0.286	0	0.000
70	2000	P/E	D	P/E	E	P	E	P/E	N	2	0.286	1	0.143
72	2000	D	D	P	E	P/E	P/E	E	N	4	0.571	2	0.286
74	2000	M	E	E	P	E	E	D	N	4	0.571	2	0.286
76	2000	E	M	E	P/E	P/E	E	P	N	3	0.429	1	0.143
78	2000	E	P/E	E	M	M	M	P	N	2	0.286	3	0.429
80	2000	E	M	E	E	P	M	P	N	3	0.429	2	0.286
Exposure Group units: mg/m3 Gevo (bio) ATJ SPK													
D = diestrus; D/P = diestrus/proestrus transition; E = estrus; ID = identification;													
M = metestrus; P/E = proestrus/estrous transition													
Abnormal cycle defined as 3 or more days of estrus in a cycle or 4 or more days of diestrus in a cycle.													
Normal Cycles: Proestrus - 1 day; Estrus - 1-2 days; Metestrus - first part of diestrus; Diestrus - 2-3 days													

APPENDIX F. SPERM PARAMETERS

Sperm Count following Exposure to Gevo (bio) ATJ SPK

Animal ID	Exposure Group	Teste Tissue Weight	Total Cells Counted	Sperm Concentration
Unit:	mg/m3	g	#	sperm/g
1	control	1.48	954	644.59
41	700	1.61	1180	732.92
21	200	1.51	894	592.05
61	2000	1.53	660	431.37
3	control	1.45	1142	787.59
43	700	1.55	762	491.61
23	200	1.49	869	583.22
63	2000	1.51	842	557.62
5	control	1.44	990	687.50
45	700	1.59	612	384.91
25	200	1.51	608	402.65
65	2000	1.41	681	482.98
7	control	1.58	1055	667.72
47	700	1.56	1279	819.87
27	200	1.72	675	392.44
135	2000	1.56	967	619.87
109	control	1.5	851	567.33
49	700	1.41	1237	877.30
129	200	1.64	806	491.46
69	2000	1.8	888	493.33
51	700	1.55	767	494.84
11	control	1.51	779	515.89
71	2000	1.45	942	649.66
31	200	1.57	713	454.14
53	700	1.48	717	484.46
13	control	1.47	653	444.22
73	2000	1.5	721	480.67
33	200	1.59	911	572.96
55	700	1.41	723	512.77
15	control	1.46	709	485.62
75	2000	1.55	1072	691.61
35	200	1.57	801	510.19
57	700	1.57	877	558.60
117	control	1.51	808	535.10
77	2000	1.52	798	525.00
37	200	1.48	752	508.11
59	700	1.64	810	493.90
19	control	1.73	636	367.63
79	2000	1.76	747	424.43
39	200	1.47	854	580.95

Sperm Motility following Exposure to Gevo (bio) ATJ SPK

Animal ID	Exposure Group	Motility	Rapid Cells	total cell count	total motile cells	total progressively motile cells	concentration total cells	concentration motile cells	concentration progressively motile cells	path velocity	progressive velocity
Unit:	mg/m3	%	%	#	#	#	millions/mL	millions/mL	millions/mL	µm/sec	µm/sec
1	control	91	91	3907	3562	1123	412.6	376.2	118.6	209.8	145.2
41	700	90	90	3537	3191	1068	373.5	337	112.8	237	164.6
21	200	86	85	4380	3751	1248	462.6	396.1	131.8	226.6	158.2
61	2000	89	89	3225	2883	980	340.6	304.5	103.5	218.6	153.7
3	control	92	91	3637	3330	1178	384.1	351.7	124.4	231.2	164.1
43	700	90	90	3475	3138	1059	367	331.4	111.8	238.8	166.2
23	200	88	88	3835	3383	1076	405	357.3	113.6	219.3	153
63	2000	88	87	4329	3807	1274	457.2	402.1	134.5	225.2	159.1
5	control	89	89	4323	3867	1364	456.5	408.4	144.1	223.1	157.5
45	700	87	86	4086	3558	1239	431.5	375.8	130.8	229.1	160.5
25	200	87	86	4157	3607	1123	439	380.9	118.6	227	156
65	2000	85	84	4176	3555	1219	441	375.4	128.7	236.8	166
7	control	86	86	4150	3580	1154	438.3	378.1	121.9	214.6	150.4
47	700	86	85	2784	2395	821	294	252.9	86.7	209.3	147.6
27	200	88	88	3495	3088	1091	369.1	326.1	115.2	208.8	148.5
135	2000	92	91	4194	3839	1373	442.9	405.4	145	231.9	164.8
109	control	87	86	3819	3319	1171	403.3	350.5	123.7	217.2	153.5
49	700	83	83	4426	3682	1264	467.4	388.9	133.5	224.7	158.3
129	200	78	78								
69	2000	80	79	4200	3377	1021	443.6	356.6	107.8	203	139.5
51	700	84	83	414	0.485	1193	437.5	368	126	207	146.4
11	control	86	85	4303	3686	1148	454.4	389.3	121.2	218.9	147.1
71	2000	86	86	3854	3326	1033	407	351.3	109.1	199.3	136.9
31	200	80	79	4311	3629	1048	155.3	383.3	110.7	229.1	153.7
53	700	89	89	3796	3384	1187	400.9	357.4	125.4	21.7	151.7
13	control	87	86	4640	4030	1308	490	425.6	138.1	224.3	155.3
73	2000	85	84	4385	3722	1138	463.1	393.1	120.2	227.1	154.1
33	200	90	90	4100	3693	1289	433	390	136.1	219.8	154.2
55	700	89	89	2618	2342	789	276.5	247.3	83.3	220.7	153.7
15	control	88	87	1733	1520	552	183	160.5	58.3	214.3	152.8
75	2000	89	88	3238	2870	1000	342	303.1	105.6	229.6	160.5
35	200	88	87	2421	2125	676	255.7	224.4	71.4	220.6	149.8
57	700	88	87	3050	2672	867	322.1	282.2	91.6	218.6	150.3
117	control	92	91	3204	2934	1019	338.4	309.9	107.6	228.1	159
77	2000	87	86	2636	2291	799	278.4	242	84.4	219.2	153.5
37	200	88	87	1200	1050	384	126.7	110.9	40.6	200.9	142.8
59	700	85	85	2121	1812	657	224	191.4	69.4	212.5	147.4
19	control	87	86	3409	2965	984	360	313.1	103.9	208.1	145.7
79	2000	84	84	3304	2782	970	348.9	293.8	102.4	208.1	147.7
39	200	89	89	2415	2148	699	255	226.8	73.8	201.8	140.4

Sperm Motility following Exposure to Gevo (bio) ATJ SPK (continued)

Animal ID	Exposure Group	tract speed	lateral amplitude	beat frequency	straight-ness	linearity	elongation	area	rapid	medium	slow	static
Unit:	mg/m3	µm/sec	µm	Hz	%	%	%	µm2	%	%	%	%
1	control	371	16.4	16.4	67	40	31	637.4	91	1	7	2
41	700	430.6	17.4	17.2	68	39	31	803.6	90	0	6	4
21	200	396.4	16.6	16.1	68	40	32	737.3	85	0	6	8
61	2000	394.2	16.9	17.6	69	40	29	626	89	0	7	4
3	control	407.7	17.1	16.5	69	41	31	816.8	91	0	5	4
43	700	429.5	17.6	17.4	68	39	31	768.7	90	0	6	4
23	200	375.4	16.6	15.3	67	41	31	627.3	88	0	6	6
63	2000	388.2	17.4	15.9	68	41	32	714.1	87	1	7	5
5	control	380.6	16.5	15.1	69	42	32	762.9	89	0	6	5
45	700	402.4	17.3	17.3	68	40	33	701.1	86	1	7	6
25	200	397.3	17.3	16.3	67	40	32	719.4	86	0	7	6
65	2000	420.1	17.7	16.6	68	40	33	786.8	84	1	8	7
7	control	365.7	16.1	15.9	68	41	33	599.5	86	1	8	6
47	700	387	16.9	18.8	69	39	28	555.1	85	1	8	6
27	200	372.6	16	16.9	70	41	30	580.1	88	0	6	5
135	2000	392.2	17.1	15	69	42	33	787.1	91	0	5	3
109	control	381	16.7	16.9	69	41	31	568.9	86	1	7	6
49	700	382.4	16.7	16.1	68	42	33	704.2	83	1	8	9
129	200											
69	2000	341.1	15.8	15.7	66	41	32	538.3	79	1	12	7
51	700	355	16.4	15.9	69	42	31	625.9	83	1	11	4
11	control	359.3	15.5	15.8	65	42	35	654.5	85	1	11	4
71	2000	341.3	15.5	15.1	66	41	30	570	86	1	7	7
31	200	390.4	15.8	15.5	65	40	32	440.5	83	1	8	7
53	700	366.7	16	16.1	68	42	30	310.8	89	0	6	5
13	control	382.6	17.1	16.9	67	41	32	329.6	86	1	9	4
73	2000	396.7	16.5	17.3	66	40	32	287.1	84	1	9	6
33	200	373.3	15.8	15.5	68	42	31	293.9	90	0	6	4
55	700	384.1	16.8	16.3	68	41	26	304.6	89	1	6	5
15	control	386.7	16.6	17.7	70	40	23	259.6	87	0	5	7
75	2000	412	17.5	17.8	68	40	28	334.6	88	0	6	5
35	200	395.9	16.9	18.1	67	39	25	295.1	87	1	8	5
57	700	389.8	16.3	17.9	67	39	28	301.5	87	0	7	5
117	control	403.2	16.6	17.2	68	40	29	346.2	91	0	6	2
77	2000	387.5	16.4	17.7	69	40	27	290.9	86	0	8	5
37	200	364.4	15.2	17.5	70	40	22	252.9	87	0	5	7
59	700	393	16.7	19.3	69	39	25	291.8	85	1	7	7
19	control	368.2	16.3	17	69	40	29	561.7	86	0	8	5
79	2000	362.4	16.2	17	69	41	29	577.7	84	1	9	7
39	200	371.2	16.1	17.4	69	39	26	549.3	89	0	6	5

Sperm Morphology following Exposure to Gevo (bio) ATJ SPK

Animal ID	Exposure Group	Normal	Abnormal	total cells assessed for morphology	total cells with normal morphology	total abnormal cells	total abnormal heads	total abnormal tails
Units:	mg/m3	%	%	#	#	#	#	#
1	control	72.6	27.4	124	90	34	1	33
41	700	78.7	21.3	127	100	27	0	27
21	200	64.7	35.3	85	55	30	1	29
61	2000	83.2	16.8	131	109	22	0	22
3	control	82.2	17.8	169	139	30	1	29
43	700	71.8	28.2	202	145	57	0	57
23	200	77	23	219	164	49	0	49
63	2000	65.2	34.8	164	107	57	3	54
5	control	65.7	34.3	239	157	82	0	82
45	700	75	25	200	150	50	0	50
25	200	66.7	33.3	144	96	48	0	48
65	2000	75	25	132	99	33	0	33
7	control	69.9	30.1	146	102	44	0	44
47	700	75.7	24.3	218	165	53	3	50
27	200	77.9	22.1	190	148	42	0	42
135	2000	71.4	28.6	224	160	64	2	62
109	control	77.9	22.1	140	109	31	0	31
49	700	82	18	122	100	22	0	22
129	200	73.4	26.6	169	124	45	0	45
69	2000	78.9	21.1	171	135	36	0	36
51	700	68.3	31.7	120	82	38	1	37
11	control	68.7	31.3	163	112	51	0	51
71	2000	73.8	26.2	141	104	37	1	36
31	200	70.7	29.3	123	87	36	1	35
53	700	75.3	24.7	146	110	36	0	36
13	control	71.1	28.9	218	155	63	0	63
73	2000	76	24	204	155	49	0	49
33	200	74.5	25.5	141	105	36	0	36
55	700	62.8	37.2	188	118	70	0	70
15	control	75	25	132	99	33	0	33
75	2000	67	33	188	126	62	0	62
35	200	67.6	32.4	185	125	60	0	60
57	700	74	26	127	94	33	0	33
117	control	70.4	29.6	179	126	53	0	53
77	2000	74.6	25.4	138	103	35	1	34
37	200	78.9	21.1	123	97	26	0	26
59	700	75.3	24.7	170	128	42	0	42
19	control	64.7	35.3	116	75	41	0	41
79	2000	72.4	27.6	156	113	43	1	42
39	200	73.4	26.6	173	127	46	0	46

APPENDIX G. GROSS PATHOLOGY AND ORGAN WEIGHTS

Gross Pathology and Necropsy Notes following Exposure to Gevo (bio) ATJ SPK

Animal ID	Dose Group (mg/m3)	Sex	Gross Pathology and Necropsy Notes
001	control	M	Station #4: Brain went into formalin before being weighed; Station #7-Lung Perfusion: 1 lobe knicked
002	control	F	
003	control	M	
004	control	F	
005	control	M	
006	control	F	Station #7-Lung Perfusion: Lungs a mess, all but one lobe perfused
007	control	M	
008	control	F	
009	control	M	
010	control	F	
011	control	M	
012	control	F	
013	control	M	Station #7-Lung Perfusion: Darker pink patches on lobes (posterior)
014	control	F	
015	control	M	
016	control	F	
017	control	M	
018	control	F	
019	control	M	
020	control	F	
021	200	M	Station #3 trachea cut just above branch, may or may not inflate; Station #5: Liver retrimmed and reweighed
022	200	F	Station #1-Incision and Blood Draw: only about 5 ml total drawn from animal
023	200	M	
024	200	F	
025	200	M	
026	200	F	
027	200	M	Station #7-Lung Perfusion: dark red spots on lobes
028	200	F	Given .05 ml extra ketamine/Xylazine dose
029	200	M	Station #5-Kidney: Both trays marked left kidney
030	200	F	
031	200	M	
032	200	F	
033	200	M	
034	200	F	
035	200	M	
036	200	F	
037	200	M	
038	200	F	
039	200	M	
040	200	F	Station #8-Additional Tissues: Corpus hemorrhagicum on one ovary
041	700	M	Station #1: edta clotted/ 1ml sst
042	700	F	
043	700	M	
044	700	F	
045	700	M	
046	700	F	
047	700	M	
048	700	F	
049	700	M	
050	700	F	
051	700	M	
052	700	F	
053	700	M	
054	700	F	
055	700	M	Station #7-Lung Perfusion: dark pink spots on several lobes
056	700	F	
057	700	M	
058	700	F	
059	700	M	
060	700	F	
061	2000	M	
062	2000	F	
063	2000	M	
064	2000	F	Station #7-Lung Perfusion: pale spots 2 lobes
065	2000	M	
066	2000	F	
067	2000	M	
068	2000	F	
069	2000	M	
070	2000	F	
071	2000	M	
072	2000	F	
073	2000	M	
074	2000	F	Given .05 ml extra ketamine/Xylazine dose
075	2000	M	
076	2000	F	
077	2000	M	Station #7-Lung Perfusion: Dark spots on lobes
078	2000	F	
079	2000	M	
080	2000	F	

Organ Weights and Percent Body Weight for Male Control Group Rats

Animal ID	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Right Epididymus (g)	Right Testicle (g)	Left Epididymus (g)	Left Testicle (g)
001	334.82	0.68	0.90	0.38	1.90	0.95	1.02	0.03	10.30	0.47	1.49	0.54	1.40
003	336.13	0.69	1.02	0.26	1.90	1.07	1.06	0.04	10.00	0.48	1.47	0.53	1.60
005	336.00	0.77	0.90	0.27	1.93	1.00	1.10	0.07	1.06	0.48	1.53	0.51	1.61
007	312.23	0.69	0.79	0.21	1.94	0.98	1.00	0.05	9.90	0.51	1.57	0.50	1.58
109	303.87	0.70	0.81	0.21	1.88	0.90	0.90	0.03	9.57	0.52	1.53	0.47	1.49
011	314.36	0.64	0.91	0.23	1.90	1.10	1.10	0.06	10.39	0.53	1.50	0.50	1.50
013	329.50	0.67	0.83	0.30	1.98	0.97	1.01	0.04	11.04	0.42	1.44	0.50	1.60
015	319.75	0.67	0.86	0.20	1.80	0.93	0.97	0.10	10.49	0.42	1.45	0.47	1.51
117	319.13	0.67	0.80	0.15	1.92	1.00	1.00	0.03	10.10	0.50	1.53	0.50	1.60
019	317.85	0.70	0.88	0.22	1.92	1.00	1.00	0.05	9.60	0.46	1.74	0.40	1.70
Mean	322.36	0.69	0.87	0.24	1.91	0.99	1.02	0.05	10.15	0.48	1.52	0.49	1.56
SD	11.20	0.03	0.07	0.06	0.05	0.06	0.06	0.02	0.46	0.04	0.08	0.04	0.08

Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Right Epididymus (% BW)	Right Testicle (% BW)	Left Epididymus (% BW)	Left Testicle (% BW)
001	334.82	0.20%	0.27%	0.11%	0.57%	0.28%	0.30%	0.01%	3.08%	0.14%	0.44%	0.16%	0.42%
003	336.13	0.21%	0.30%	0.08%	0.57%	0.32%	0.32%	0.01%	2.98%	0.14%	0.44%	0.16%	0.48%
005	336.00	0.23%	0.27%	0.08%	0.57%	0.30%	0.33%	0.02%		0.14%	0.45%	0.15%	0.48%
007	312.23	0.22%	0.25%	0.07%	0.62%	0.31%	0.32%	0.02%	3.17%	0.16%	0.50%	0.16%	0.51%
109	303.87	0.23%	0.27%	0.07%	0.62%	0.30%	0.30%	0.01%	3.15%	0.17%	0.50%	0.15%	0.49%
011	314.36	0.20%	0.29%	0.07%	0.60%	0.35%	0.35%	0.02%	3.31%	0.17%	0.48%	0.16%	0.48%
013	329.50	0.20%	0.25%	0.09%	0.60%	0.29%	0.31%	0.01%	3.35%	0.13%	0.44%	0.15%	0.49%
015	319.75	0.21%	0.27%	0.06%	0.56%	0.29%	0.30%	0.03%	3.28%	0.13%	0.45%	0.15%	0.47%
117	319.13	0.21%	0.25%	0.05%	0.60%	0.31%	0.31%	0.01%	3.16%	0.16%	0.48%	0.16%	0.50%
019	317.85	0.22%	0.28%	0.07%	0.60%	0.31%	0.31%	0.02%	3.02%	0.15%	0.55%	0.13%	0.53%
Mean	322.36	0.21%	0.27%	0.08%	0.59%	0.31%	0.32%	0.02%	3.17%	0.15%	0.47%	0.15%	0.48%
SD	11.20	0.01%	0.02%	0.02%	0.02%	0.02%	0.02%	0.01%	0.13%	0.02%	0.04%	0.01%	0.03%

The value highlighted in blue was recorded incorrectly, but no indication of anomaly was recorded at necropsy. Therefore, the value was excluded from the average and from the percent bodyweight calculations.

Organ Weights and Percent Body Weight for Female Control Group Rats

Animal #	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Uterus and Ovaries (g)	Uterus (g)	Ovaries (g)
002	193.04	0.55	0.53	0.26	1.84	0.60	0.70	0.06	5.73	0.51	0.42	0.09
004	190.21	0.52	0.58	0.21	1.83	0.70	0.70	0.07	5.70	0.78	0.69	0.09
006	177.98	0.49	0.53	0.23	1.72	0.60	0.60	0.07	5.70	0.60	0.50	0.10
008	173.71	0.42	0.36	0.27	1.81	0.56	0.56	0.05	4.75	1.17	1.07	0.10
010	192.43	0.50	0.60	0.30	1.80	0.60	0.70	0.06	5.50	0.50	0.40	0.10
012	173.19	0.43	0.48	0.22	1.78	0.60	0.60	0.05	5.20	1.10	1.00	0.10
014	183.56	0.40	0.60	0.25	1.80	0.60	0.60	0.05	5.30	0.60	0.50	0.10
016	179.50	0.49	0.60	0.22	1.75	0.60	0.60	0.05	5.40	0.60	0.50	0.10
018	181.18	0.41	0.52	0.22	1.73	0.60	0.50	0.06	5.30	0.50	0.40	0.10
020	179.05	0.46	0.60	0.18	1.78	0.62	0.62	0.05	5.28	0.47	0.37	0.10
Mean	182.39	0.47	0.54	0.24	1.78	0.61	0.62	0.06	5.39	0.68	0.59	0.10
SD	7.28	0.05	0.08	0.03	0.04	0.04	0.07	0.01	0.30	0.25	0.25	0.004

Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Uterus and Ovaries (% BW)	Uterus (% BW)	Ovaries (% BW)
002	193.04	0.28%	0.27%	0.13%	0.95%	0.31%	0.36%	0.03%	2.97%	0.26%	0.22%	0.05%
004	190.21	0.27%	0.30%	0.11%	0.96%	0.37%	0.37%	0.04%	3.00%	0.41%	0.36%	0.05%
006	177.98	0.28%	0.30%	0.13%	0.97%	0.34%	0.34%	0.04%	3.20%	0.34%	0.28%	0.06%
008	173.71	0.24%	0.21%	0.16%	1.04%	0.32%	0.32%	0.03%	2.73%	0.67%	0.62%	0.06%
010	192.43	0.26%	0.31%	0.16%	0.94%	0.31%	0.36%	0.03%	2.86%	0.26%	0.21%	0.05%
012	173.19	0.25%	0.28%	0.13%	1.03%	0.35%	0.35%	0.03%	3.00%	0.64%	0.58%	0.06%
014	183.56	0.22%	0.33%	0.14%	0.98%	0.33%	0.33%	0.03%	2.89%	0.33%	0.27%	0.05%
016	179.50	0.27%	0.33%	0.12%	0.97%	0.33%	0.33%	0.03%	3.01%	0.33%	0.28%	0.06%
018	181.18	0.23%	0.29%	0.12%	0.95%	0.33%	0.28%	0.03%	2.93%	0.28%	0.22%	0.06%
020	179.05	0.26%	0.34%	0.10%	0.99%	0.35%	0.35%	0.03%	2.95%	0.26%	0.21%	0.06%
Mean	182.39	0.26%	0.30%	0.13%	0.98%	0.33%	0.34%	0.03%	2.95%	0.38%	0.32%	0.05%
SD	7.28	0.02%	0.04%	0.02%	0.03%	0.02%	0.03%	0.00%	0.12%	0.15%	0.15%	0.004%

**Organ Weights and Percent Body Weight for Male 200 mg/m³ Gevo (bio) ATJ SPK
Exposure Group Rats**

Animal ID	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Right Epididymus (g)	Right Testicle (g)	Left Epididymus (g)	Left Testicle (g)
021	315.24	0.76	0.82	0.19	1.94	1.10	1.10	0.06	9.20	0.46	1.47	0.50	1.50
023	313.20	0.72	0.82	0.23	1.93	1.00	1.00	0.06	9.70	0.53	1.55	0.40	1.60
025	295.02	0.74	0.80	0.29	1.84	0.94	0.95	0.06	9.87	0.48	1.47	0.53	1.50
027	355.43	0.70	0.90	0.35	1.85	1.00	1.00	0.04	11.30	0.45	1.63	0.51	1.68
129	330.21	0.66	0.83	0.24	1.85	0.99	1.03	0.07	10.20	0.51	1.57	0.52	1.64
031	344.88	0.81	0.83	0.24	1.90	1.13	1.18	0.05	11.50	0.48	1.54	0.50	1.62
033	354.84	0.73	0.91	0.18	1.88	1.12	1.16	0.06	11.90	0.44	1.60	0.29	0.86
035	347.13	0.66	1.00	0.22	1.96	1.10	1.06	0.02	11.40	0.49	1.53	0.40	1.50
037	313.00	0.85	0.82	0.24	1.88	1.00	1.00	0.04	9.80	0.44	1.49	0.50	1.60
039	324.80	0.67	0.94	0.22	2.00	0.99	0.97	0.05	10.25	0.45	1.52	0.50	1.60
Mean	329.38	0.73	0.87	0.24	1.90	1.04	1.05	0.05	10.51	0.47	1.54	0.47	1.51
SD	20.59	0.06	0.07	0.05	0.05	0.07	0.08	0.01	0.93	0.03	0.05	0.08	0.24
Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Right Epididymus (% BW)	Right Testicle (% BW)	Left Epididymus (% BW)	Left Testicle (% BW)
021	315.24	0.24%	0.26%	0.06%	0.62%	0.35%	0.35%	0.02%	2.92%	0.15%	0.47%	0.16%	0.48%
023	313.20	0.23%	0.26%	0.07%	0.62%	0.32%	0.32%	0.02%	3.10%	0.17%	0.49%	0.13%	0.51%
025	295.02	0.25%	0.27%	0.10%	0.62%	0.32%	0.32%	0.02%	3.35%	0.16%	0.50%	0.18%	0.51%
027	355.43	0.20%	0.25%	0.10%	0.52%	0.28%	0.28%	0.01%	3.18%	0.13%	0.46%	0.14%	0.47%
129	330.21	0.20%	0.25%	0.07%	0.56%	0.30%	0.31%	0.02%	3.09%	0.16%	0.48%	0.16%	0.50%
031	344.88	0.23%	0.24%	0.07%	0.55%	0.33%	0.34%	0.01%	3.33%	0.14%	0.45%	0.14%	0.47%
033	354.84	0.21%	0.26%	0.05%	0.53%	0.32%	0.33%	0.02%	3.35%	0.12%	0.45%	0.08%	0.24%
035	347.13	0.19%	0.29%	0.06%	0.56%	0.32%	0.31%	0.01%	3.28%	0.14%	0.44%	0.12%	0.43%
037	313.00	0.27%	0.26%	0.08%	0.60%	0.32%	0.32%	0.01%	3.13%	0.14%	0.48%	0.16%	0.51%
039	324.80	0.21%	0.29%	0.07%	0.62%	0.30%	0.30%	0.02%	3.16%	0.14%	0.47%	0.15%	0.49%
Mean	329.38	0.22%	0.26%	0.07%	0.58%	0.32%	0.32%	0.02%	3.19%	0.14%	0.47%	0.14%	0.46%
SD	20.59	0.03%	0.02%	0.02%	0.04%	0.02%	0.02%	0.005%	0.14%	0.01%	0.02%	0.03%	0.08%

**Organ Weights and Percent Body Weight for Female 200 mg/m³ Gevo (bio) ATJ SPK
Exposure Group Rats**

Animal ID	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Uterus and Ovaries (g)	Uterus (g)	Ovaries (g)
022	165.99	0.50	0.47	0.20	11.70	0.50	0.60	0.04	4.84	0.52	0.38	0.14
024	168.89	0.43	0.49	0.21	1.78	0.60	0.60	0.05	4.56	0.50	0.30	0.20
026	177.93	0.44	0.58	0.17	1.80	0.60	0.60	0.04	4.92	1.21	1.13	0.08
028	181.50	0.51	0.51	0.22	1.78	0.50	0.60	0.05	4.90	0.60	0.40	0.20
030	195.67	0.52	0.60	0.25	1.81	0.60	0.60	0.06	5.30	0.70	0.60	0.10
032	191.56	0.50	0.52	0.27	1.71	0.60	0.70	0.05	6.30	0.80	0.60	0.20
034	187.39	0.50	0.60	0.24	1.80	0.60	0.60	0.06	6.20	0.70	0.60	0.10
036	174.14	0.52	0.48	0.23	1.71	0.50	0.60	0.06	5.50	1.10	1.00	0.10
038	174.59	0.50	0.50	0.19	1.80	0.60	0.60	0.05	5.40	0.60	0.50	0.10
040	198.42	0.49	0.61	0.32	1.76	0.60	0.70	0.07	6.00	0.90	0.71	0.19
Mean	181.61	0.49	0.54	0.23	1.77	0.57	0.62	0.05	5.39	0.76	0.62	0.14
SD	11.24	0.03	0.06	0.04	0.04	0.05	0.04	0.01	0.61	0.24	0.27	0.05

Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Uterus and Ovaries (% BW)	Uterus (% BW)	Ovaries (% BW)
022	165.99	0.30%	0.28%	0.12%		0.30%	0.36%	0.02%	2.92%	0.31%	0.23%	0.08%
024	168.89	0.25%	0.29%	0.12%	1.05%	0.36%	0.36%	0.03%	2.70%	0.30%	0.18%	0.12%
026	177.93	0.25%	0.33%	0.10%	1.01%	0.34%	0.34%	0.02%	2.77%	0.68%	0.64%	0.04%
028	181.50	0.28%	0.28%	0.12%	0.98%	0.28%	0.33%	0.03%	2.70%	0.33%	0.22%	0.11%
030	195.67	0.27%	0.31%	0.13%	0.93%	0.31%	0.31%	0.03%	2.71%	0.36%	0.31%	0.05%
032	191.56	0.26%	0.27%	0.14%	0.89%	0.31%	0.37%	0.03%	3.29%	0.42%	0.31%	0.10%
034	187.39	0.27%	0.32%	0.13%	0.96%	0.32%	0.32%	0.03%	3.31%	0.37%	0.32%	0.05%
036	174.14	0.30%	0.28%	0.13%	0.98%	0.29%	0.34%	0.03%	3.16%	0.63%	0.57%	0.06%
038	174.59	0.29%	0.29%	0.11%	1.03%	0.34%	0.34%	0.03%	3.09%	0.34%	0.29%	0.06%
040	198.42	0.25%	0.31%	0.16%	0.89%	0.30%	0.35%	0.04%	3.02%	0.45%	0.36%	0.10%
Mean	181.61	0.27%	0.29%	0.13%	0.97%	0.31%	0.34%	0.03%	2.97%	0.42%	0.34%	0.08%
SD	11.24	0.02%	0.02%	0.02%	0.06%	0.03%	0.02%	0.004%	0.24%	0.13%	0.15%	0.03%

The value highlighted in blue was recorded incorrectly, but no indication of anomaly was recorded at necropsy. Therefore, the value was excluded from the average and from the percent bodyweight calculations.

**Organ Weights and Percent Body Weight for Male 700 mg/m³ Gevo (bio) ATJ SPK
Exposure Group Rats**

Animal ID	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Right Epididymus (g)	Right Testicle (g)	Left Epididymus (g)	Left Testicle (g)
041	292.75	0.61	0.82	0.31	1.86	0.97	0.92	0.04	9.10	0.45	1.40	0.51	1.53
043	310.60	0.65	0.84	0.22	1.89	0.90	0.90	0.06	9.10	0.44	1.46	0.49	1.49
045	308.08	0.67	0.79	0.27	1.82	0.90	1.00	0.06	9.40	0.45	1.48	0.50	1.50
047	323.43	0.65	0.80	0.39	1.89	1.00	0.90	0.09	9.70	0.48	1.55	0.45	1.57
049	307.66	0.60	0.81	0.26	1.87	1.00	0.90	0.04	9.60	0.41	1.39	0.50	1.50
051	314.07	0.66	0.86	0.24	1.94	1.00	0.90	0.06	10.50	0.51	1.55	0.50	1.60
053	299.91	0.60	0.74	0.19	1.77	0.90	0.90	0.05	9.80	0.45	1.48	0.46	1.52
055	340.27	0.65	0.87	0.26	1.96	1.10	1.10	0.06	11.50	0.42	1.40	0.40	1.50
057	307.76	0.72	0.86	0.27	1.87	1.00	1.00	0.08	10.40	0.46	1.50	0.50	1.70
059	359.26	0.60	0.93	0.28	1.99	1.06	1.08	0.07	10.70	0.47	1.60	0.40	1.60
Mean	316.38	0.64	0.83	0.27	1.89	0.98	0.96	0.06	9.98	0.45	1.48	0.47	1.55
SD	19.85	0.04	0.05	0.05	0.07	0.07	0.08	0.02	0.78	0.03	0.07	0.04	0.07

Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Right Epididymus (% BW)	Right Testicle (% BW)	Left Epididymus (% BW)	Left Testicle (% BW)
041	292.75	0.21%	0.28%	0.11%	0.64%	0.33%	0.31%	0.01%	3.11%	0.15%	0.48%	0.17%	0.52%
043	310.60	0.21%	0.27%	0.07%	0.61%	0.29%	0.29%	0.02%	2.93%	0.14%	0.47%	0.16%	0.48%
045	308.08	0.22%	0.26%	0.09%	0.59%	0.29%	0.32%	0.02%	3.05%	0.15%	0.48%	0.16%	0.49%
047	323.43	0.20%	0.25%	0.12%	0.58%	0.31%	0.28%	0.03%	3.00%	0.15%	0.48%	0.14%	0.49%
049	307.66	0.20%	0.26%	0.08%	0.61%	0.33%	0.29%	0.01%	3.12%	0.13%	0.45%	0.16%	0.49%
051	314.07	0.21%	0.27%	0.08%	0.62%	0.32%	0.29%	0.02%	3.34%	0.16%	0.49%	0.16%	0.51%
053	299.91	0.20%	0.25%	0.06%	0.59%	0.30%	0.30%	0.02%	3.27%	0.15%	0.49%	0.15%	0.51%
055	340.27	0.19%	0.26%	0.08%	0.58%	0.32%	0.32%	0.02%	3.38%	0.12%	0.41%	0.12%	0.44%
057	307.76	0.23%	0.28%	0.09%	0.61%	0.32%	0.32%	0.03%	3.38%	0.15%	0.49%	0.16%	0.55%
059	359.26	0.17%	0.26%	0.08%	0.55%	0.30%	0.30%	0.02%	2.98%	0.13%	0.45%	0.11%	0.45%
Mean	316.38	0.20%	0.26%	0.09%	0.60%	0.31%	0.30%	0.02%	3.16%	0.14%	0.47%	0.15%	0.49%
SD	19.85	0.02%	0.01%	0.02%	0.02%	0.02%	0.02%	0.005%	0.17%	0.01%	0.03%	0.02%	0.03%

**Organ Weights and Percent Body Weight for Female 700 mg/m³ Gevo (bio) ATJ SPK
Exposure Group Rats**

Animal ID	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Uterus and Ovaries (g)	Uterus (g)	Ovaries (g)
042	182.86	0.53	0.57	0.26	1.81	0.80	0.80	0.07	6.80	1.24	1.15	0.09
044	203.15	0.53	0.60	0.19	1.80	0.70	0.60	0.07	5.60	1.30	1.20	0.10
046	201.81	0.52	0.55	0.24	1.70	0.68	0.69	0.06	5.64	0.89	0.77	0.12
048	204.46	0.60	0.60	0.24	1.78	0.60	0.60	0.08	5.20	1.10	0.90	0.20
050	178.46	0.47	0.54	0.23	1.78	0.50	0.60	0.04	5.10	0.55	0.43	0.12
052	189.38	0.50	0.54	0.27	1.79	0.60	0.70	0.05	5.80	0.70	0.60	0.10
054	177.51	0.50	0.51	0.32	1.80	0.60	0.60	0.06	5.70	0.60	0.50	0.10
056	200.19	0.50	0.50	0.28	1.84	0.70	0.70	0.05	5.60	0.40	0.30	0.10
058	188.42	0.53	0.58	0.26	1.78	0.70	0.60	0.07	5.40	1.21	1.05	0.16
060	182.98	0.47	0.62	0.19	1.85	0.58	0.63	0.04	5.10	0.53	0.44	0.09
Mean	190.92	0.52	0.56	0.25	1.79	0.65	0.65	0.06	5.59	0.85	0.73	0.12
SD	10.59	0.04	0.04	0.04	0.04	0.09	0.07	0.01	0.49	0.34	0.33	0.04

Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Uterus and Ovaries (% BW)	Uterus (% BW)	Ovaries (% BW)
042	182.86	0.29%	0.31%	0.14%	0.99%	0.44%	0.44%	0.04%	3.72%	0.68%	0.63%	0.05%
044	203.15	0.26%	0.30%	0.09%	0.89%	0.34%	0.30%	0.03%	2.76%	0.64%	0.59%	0.05%
046	201.81	0.26%	0.27%	0.12%	0.84%	0.34%	0.34%	0.03%	2.79%	0.44%	0.38%	0.06%
048	204.46	0.29%	0.29%	0.12%	0.87%	0.29%	0.29%	0.04%	2.54%	0.54%	0.44%	0.10%
050	178.46	0.26%	0.30%	0.13%	1.00%	0.28%	0.34%	0.02%	2.86%	0.31%	0.24%	0.07%
052	189.38	0.26%	0.29%	0.14%	0.95%	0.32%	0.37%	0.03%	3.06%	0.37%	0.32%	0.05%
054	177.51	0.28%	0.29%	0.18%	1.01%	0.34%	0.34%	0.03%	3.21%	0.34%	0.28%	0.06%
056	200.19	0.25%	0.25%	0.14%	0.92%	0.35%	0.35%	0.02%	2.80%	0.20%	0.15%	0.05%
058	188.42	0.28%	0.31%	0.14%	0.94%	0.37%	0.32%	0.04%	2.87%	0.64%	0.56%	0.08%
060	182.98	0.26%	0.34%	0.10%	1.01%	0.32%	0.34%	0.02%	2.79%	0.29%	0.24%	0.05%
Mean	190.92	0.27%	0.29%	0.13%	0.94%	0.34%	0.34%	0.03%	2.94%	0.44%	0.38%	0.06%
SD	10.59	0.02%	0.02%	0.02%	0.06%	0.04%	0.04%	0.01%	0.33%	0.17%	0.17%	0.02%

**Organ Weights and Percent Body Weight for Male 2000 mg/m³ Gevo (bio) ATJ SPK
Exposure Group Rats**

Animal ID	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Right Epididymus (g)	Right Testicle (g)	Left Epididymus (g)	Left Testicle (g)
061	333.69	0.73	0.85	0.24	1.96	0.90	1.00	0.04	10.60	0.47	1.50	0.40	1.60
063	303.81	0.66	0.77	0.27	1.93	1.00	1.00	0.09	10.00	0.46	1.44	0.48	1.53
065	326.41	0.67	0.88	0.20	1.90	0.90	1.00	0.05	10.40	0.46	1.39	0.50	1.50
135	330.37	0.70	0.81	0.30	1.93	0.98	0.98	0.07	10.57	0.49	1.53	0.50	1.53
069	370.81	0.86	0.89	0.25	1.88	1.10	1.00	0.08	11.70	0.53	1.65	0.51	1.67
071	347.91	0.73	0.74	0.16	1.92	1.00	1.00	0.04	12.00	0.47	1.46	0.50	1.60
073	319.74	0.60	0.93	0.23	1.91	1.09	1.07	0.06	10.68	0.48	1.51	0.50	1.50
075	335.72	0.74	0.88	0.26	1.86	1.02	1.00	0.06	10.90	0.46	1.53	0.40	1.60
077	313.55	0.60	0.77	0.18	1.90	1.00	0.90	0.06	10.60	0.48	1.52	0.40	1.50
079	355.53	0.73	0.91	0.23	1.98	0.93	1.04	0.04	11.43	0.45	1.67	0.49	1.72
Mean	333.75	0.70	0.84	0.23	1.92	0.99	1.00	0.06	10.89	0.48	1.52	0.47	1.58
SD	20.05	0.08	0.07	0.04	0.04	0.07	0.04	0.02	0.63	0.02	0.08	0.05	0.08
Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Right Epididymus (% BW)	Right Testicle (% BW)	Left Epididymus (% BW)	Left Testicle (% BW)
061	333.69	0.22%	0.25%	0.07%	0.59%	0.27%	0.30%	0.01%	3.18%	0.14%	0.45%	0.12%	0.48%
063	303.81	0.22%	0.25%	0.09%	0.64%	0.33%	0.33%	0.03%	3.29%	0.15%	0.47%	0.16%	0.50%
065	326.41	0.21%	0.27%	0.06%	0.58%	0.28%	0.31%	0.02%	3.19%	0.14%	0.43%	0.15%	0.46%
135	330.37	0.21%	0.25%	0.09%	0.58%	0.30%	0.30%	0.02%	3.20%	0.15%	0.46%	0.15%	0.46%
069	370.81	0.23%	0.24%	0.07%	0.51%	0.30%	0.27%	0.02%	3.16%	0.14%	0.44%	0.14%	0.45%
071	347.91	0.21%	0.21%	0.05%	0.55%	0.29%	0.29%	0.01%	3.45%	0.14%	0.42%	0.14%	0.46%
073	319.74	0.19%	0.29%	0.07%	0.60%	0.34%	0.33%	0.02%	3.34%	0.15%	0.47%	0.16%	0.47%
075	335.72	0.22%	0.26%	0.08%	0.55%	0.30%	0.30%	0.02%	3.25%	0.14%	0.46%	0.12%	0.48%
077	313.55	0.19%	0.25%	0.06%	0.61%	0.32%	0.29%	0.02%	3.38%	0.15%	0.49%	0.13%	0.48%
079	355.53	0.21%	0.26%	0.06%	0.56%	0.26%	0.29%	0.01%	3.21%	0.13%	0.47%	0.14%	0.48%
Mean	333.75	0.21%	0.25%	0.07%	0.58%	0.30%	0.30%	0.02%	3.26%	0.14%	0.46%	0.14%	0.47%
SD	20.05	0.01%	0.02%	0.01%	0.04%	0.03%	0.02%	0.01%	0.10%	0.01%	0.02%	0.01%	0.02%

**Organ Weights and Percent Body Weight for Female 2000 mg/m³ Gevo (bio) ATJ SPK
Exposure Group Rats**

Animal ID	Body Weight (g)	Spleen (g)	Heart (g)	Thymus (g)	Brain (g)	Right Kidney (g)	Left Kidney (g)	Adrenal Glands (g)	Liver (g)	Uterus and Ovaries (g)	Uterus (g)	Ovaries (g)
062	200.74	0.50	0.60	0.30	1.87	0.70	0.70	0.06	6.40	0.70	0.50	0.20
064	177.05	0.49	0.50	0.24	1.79	0.63	0.62	0.07	5.60	0.69	0.62	0.07
066	186.66	0.49	0.56	0.22	1.81	0.70	0.70	0.06	5.70	0.92	0.83	0.09
068	157.38	0.46	0.45	0.24	1.68	0.50	0.60	0.04	4.59	0.36	0.27	0.09
070	174.10	0.50	0.46	0.27	1.70	0.50	0.60	0.05	5.20	0.60	0.40	0.20
072	173.02	0.40	0.50	0.23	1.77	0.60	0.60	0.07	5.60	0.60	0.50	0.10
074	184.69	0.50	0.48	0.27	1.69	0.60	0.60	0.06	6.00	0.60	0.50	0.10
076	183.70	0.50	0.60	0.23	1.83	0.70	0.70	0.05	5.60	0.50	0.40	0.10
078	197.56	0.50	0.62	0.32	1.80	0.70	0.70	0.07	6.00	1.10	1.00	0.10
080	182.69	0.48	0.54	0.23	1.75	0.62	0.62	0.06	5.40	0.50	0.40	0.10
Mean	181.76	0.48	0.53	0.26	1.77	0.63	0.64	0.06	5.61	0.66	0.54	0.12
SD	12.47	0.03	0.06	0.03	0.06	0.08	0.05	0.01	0.49	0.21	0.22	0.05

Animal ID	Body Weight (g)	Spleen (% BW)	Heart (% BW)	Thymus (% BW)	Brain (% BW)	Right Kidney (% BW)	Left Kidney (% BW)	Adrenal Glands (% BW)	Liver (% BW)	Uterus and Ovaries (% BW)	Uterus (% BW)	Ovaries (% BW)
062	200.74	0.25%	0.30%	0.15%	0.93%	0.35%	0.35%	0.03%	3.19%	0.35%	0.25%	0.10%
064	177.05	0.28%	0.28%	0.14%	1.01%	0.36%	0.35%	0.04%	3.16%	0.39%	0.35%	0.04%
066	186.66	0.26%	0.30%	0.12%	0.97%	0.38%	0.38%	0.03%	3.05%	0.49%	0.44%	0.05%
068	157.38	0.29%	0.29%	0.15%	1.07%	0.32%	0.38%	0.03%	2.92%	0.23%	0.17%	0.06%
070	174.10	0.29%	0.26%	0.16%	0.98%	0.29%	0.34%	0.03%	2.99%	0.34%	0.23%	0.11%
072	173.02	0.23%	0.29%	0.13%	1.02%	0.35%	0.35%	0.04%	3.24%	0.35%	0.29%	0.06%
074	184.69	0.27%	0.26%	0.15%	0.92%	0.32%	0.32%	0.03%	3.25%	0.32%	0.27%	0.05%
076	183.70	0.27%	0.33%	0.13%	1.00%	0.38%	0.38%	0.03%	3.05%	0.27%	0.22%	0.05%
078	197.56	0.25%	0.31%	0.16%	0.91%	0.35%	0.35%	0.04%	3.04%	0.56%	0.51%	0.05%
080	182.69	0.26%	0.30%	0.13%	0.96%	0.34%	0.34%	0.03%	2.96%	0.27%	0.22%	0.05%
Mean	181.76	0.27%	0.29%	0.14%	0.98%	0.34%	0.35%	0.03%	3.08%	0.36%	0.29%	0.06%
SD	12.47	0.02%	0.02%	0.01%	0.05%	0.03%	0.02%	0.00%	0.12%	0.10%	0.11%	0.02%

APPENDIX H. COMPLETE PATHOLOGY REPORT

Final Report – 90-Day Inhalation Toxicity Study of Bio-Derived Gevo Jet Fuel in Rats (*Rattus norvegicus*) with Neurotoxicity Testing and Genotoxicity Assay

Study Protocol: F-WA-2013-0144A
Date of Report: 10 Jun 2014

Study Director: Dr. Mumy
Study Pathologist: D.E. Stoffregen

NARRATIVE PATHOLOGY REPORT

Accession Number Groups and Animal Numbers

Controls: 130115 to 130134; R-1 thru R-20; (R-9 replaced w/ R-109; R-17 replaced w/ R-117)
Low Dose: 130135 to 130154; R-21 thru R-40; (R-29 replaced w/ R-129)
Mid Dose: 130155 to 130174; R-41 to R-60
High Dose: 130175 to 130194; R-61 to R-80 (R-67 replaced w/ R-135)

History

This study investigated the inhalation toxicity of biologically derived Gevo Jet Blend Stock fuel to Fischer 344 rats over a 13 week period to establish an occupational permissible exposure level for safe use of the fuel. The bio-derived Gevo jet fuel was administered by whole-body inhalation exposure at three concentrations plus a control level (2000, 700, 200, and 0 mg/m³) to Fischer 344 rats (10 rats per sex per dose) on a repeated basis (6 hours per day) for 5 days per week for 13 weeks.

Prior to the end of the exposures, animals were subjected to functional observations to evaluate any signs of toxicity related to the nervous system that may have affected behavior. The female estrous cycle and male sperm motility and morphology were analyzed to assess potential reproductive toxicity. At the end of the study, the rats were euthanized, and select tissues per OECD guidelines were collected and submitted for histopathological examination.

Supporting Documentation

The test results for neurotoxicity and reproductive toxicity reside with the Principal Investigator, and no abnormal results were reported to the pathologist.

Gross Observations

No gross observations were noted or recorded during necropsy and tissue trimming.

Histopathology by Animal

Formalin fixed, paraffin embedded, 5 micron, H&E stained sections of selected tissues were submitted for histopathologic evaluation. The histopathologic coding and diagnoses are listed on the attached Excel grading spreadsheet under the Block # / tissue and comments, respectively, by their respective accession numbers. The individual animal reports, grading and pictures are retained with the pathologist at AFRL/TSRL-SA on the Filemaker database in the Common drive (Pathology Department > LTC Stoffregen > Pathology –Protocols (TSRL, NAMRU) > Protocols – TSRL; NAMRU > NAMRU-D > Protocol 13-0144 - Gevo (Mummy) > Grading or Pictures, and are available upon request.

Discussion

The histopathology results have not been analyzed for statistical significance.

Respiratory System

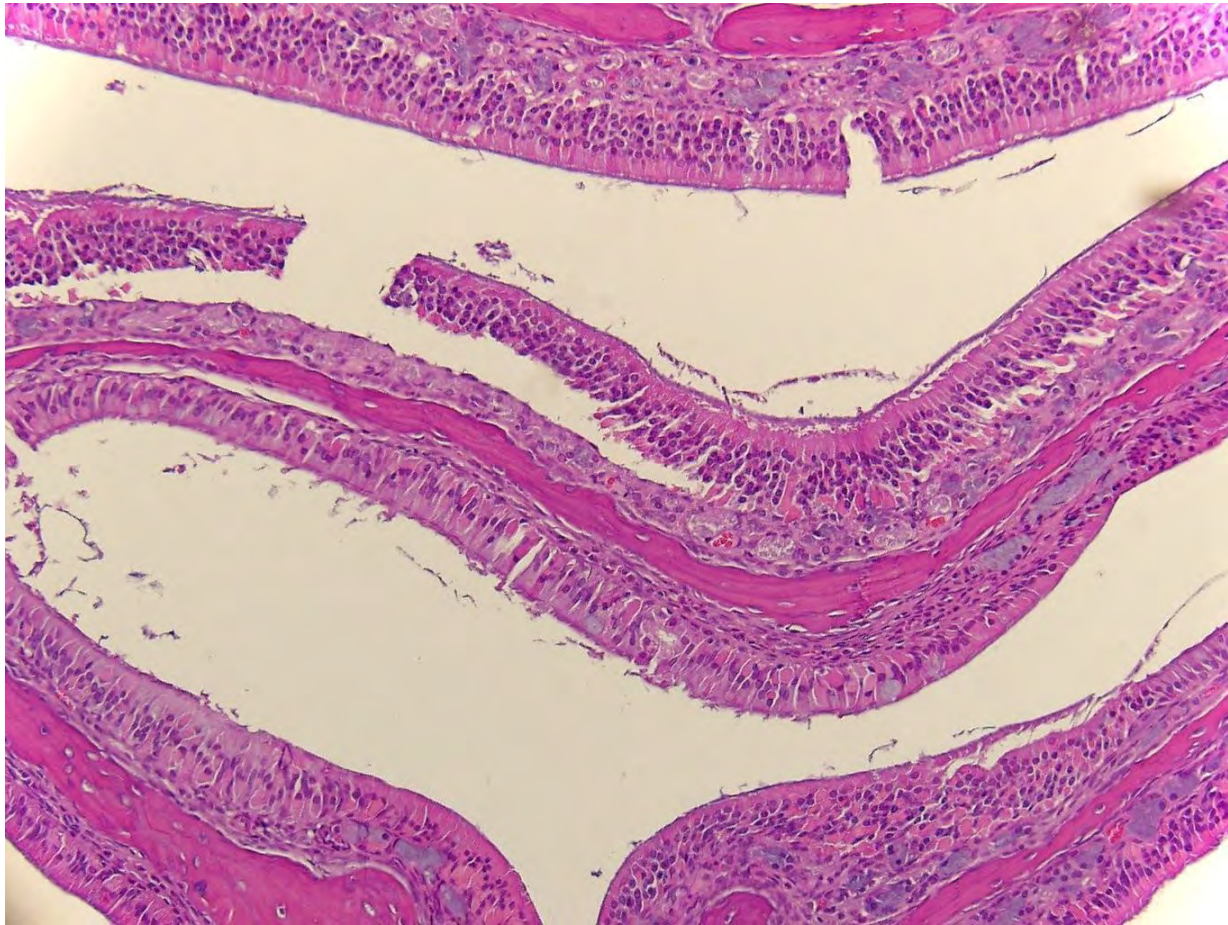
Table 1. Respiratory Lesions – Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	Low Dose Group	Mid Dose Group	High Dose Group
Nasal Cavity				
Cytoplasmic Eosinophilic Globules				
Level 1 - Respiratory		F – 1(R)		F – 3 (R); 1(R*); 1 (+) M – 1 (R); 1 (+*)
Olfactory			F – 1(R)	F – 1 (R*) M – 1 (R); 1 (++)
Level 2 - Respiratory	F – 1(R)		F – 1(+*) M – 3(R)	F – 1 (R); 1 (+*); 4 (+++); 3(+++*) M – 1(R*); 1(+); 1(+*); 2(++); 4(+++*)
Olfactory	F – 1(R)	F – 5(R) M – 2(R); 2(+)	F – 3(R); 1(+*) M – 2(R)	F – 1(R); 4 (+*); 3(+++); 1(+++*) M – 2(+*); 5(+++*)
Level 3 - Respiratory	F – 1(R*)		F – 1(R); 1(+*) M – 1(R)	F – 6(+++); 4(+++*) M – 2(+*); 5(+++); 3(+++*)
Olfactory	F – 7(R); 1(R*); 2(+) M – 4(R)	F – 7(R); 3(+) M – 7(R); 3(+)	F – 6(R); 2(+); 1(+*) M – 4(R); 5(+)	F – 4(+++); 6(+++*) M – 2(+*); 6(+++); 2(+++*)
Level 4 - Respiratory				F – 5(+++); 4(+++*) M – 3(+*); 6(+++)
Olfactory	F – 4(R); 1(+) M – 5(R); 1(+)	F – 7(R); 2(+) M – 6(R); 2(+)	F – 5(R); 3(+) M – 4(R); 4 (+); 1(+*)	F – 1(++); 6(+++); 3(+++*) M – 1(+); 2(+*); 6(+++); 1(+++*)
Goblet Cell Hyperplasia				
Level 1	F – 1 (+)			F – 1(R); 1(+)
Level 2				F – 1(R); 4(+); 1(++) M – 3(+); 2(++)
Level 3				F – 5(+) M – 2(+); 1 (++)
Level 4				F – 1(+)
Inflammation				
Level 1	F – 4(R) M – 2(R); 1 (+)	F – 1(+)	F – 2(R) M – 4(R); 1(+)	F – 2(R) M – 1(R)
Level 2	F – 1(R) M – 3(R); 2(+)	M – 1(+)	M – 1(R)	M – 2(R); 1(+)
Level 3	F – 1 (R)		F – 1(R); 1(R*); 1 (+*) M – 2(+)	
Level 4	F – 2 (R)			F – 1(+)
Corpora Amylacea				
Level 1	F – 6(+); 2(++) M – 1(R); 7(+)	F – 1(R); 4(+) M – 2(R); 7(+)	F – 3(R); 2(+) M – 2(R); 4(+)	F – 5(R) M – 7(R); 1(+)
Level 2	F – 1(R); 3(+); 1(++) M – 1(R); 6(+); 2(++)	F – 1(R); 6(+); 1(++) M – 2(+); 7(++)	F – 3(R); 4(+); 1(++) M – 3(R); 3(+); 2(++)	F – 1(R); 3(+) M – 3(R); 2(+)
Level 3	F – 4(+); 7(++) M – 1(+); 9(++)	F – 2(R); 7(+); 1(++) M – 2(R); 7(+); 1(++)	F – 8(+); 2(++) M – 2(R); 4(+); 4(++)	F – 5(+) M – 7(+); 2(++)
Level 4	F – 3(+); 6(++) M – 1(+); 9(++)	F – 1(R); 8(+); 1(++) M – 4(+); 3(++)	F – 3(R); 5(+); 1(++) M – 5(+); 4(++)	F – 9(+) M – 7(+)
Lungs				
Inflammation	F – 3(R); M – 6(R)	F – 3(R); M – 1(R)	F – 4(R); M – 3(R)	F – 5(+); M – 4 (+)
Mineralization	F – 3(R); M – 5(R)	F – 4(R); M – 5(R)	F – 3(R); M – 4(R)	F – 1(+); M – 6(+)
Hemorrhage	M – 4(+)	M – 3(+)	F – 3(+); M – 1(+)	F – 1(+); M – 4(+)

M = Male; F = Female; Rare (R), Minimal (+), Mild (++), Moderate (+++); Respiratory and olfactory epithelium affected on same nasal cavity level of the same animal (*)

Nasal Cavity

Cytoplasmic eosinophilic globules or inclusions - are commonly observed in the nasal epithelium of aging rats. The inclusions occur in the olfactory, respiratory and transitional epithelium and mucous glands. The inclusion material is thought to be proteinaceous and on electron microscopy, appears as amorphous, flocculent material in cytoplasmic membrane-bound vacuoles.



Cytoplasmic eosinophilic globules (inclusions). Respiratory and olfactory epithelium, Rat 78, Level 4, High Dose Group. 20X

Results for incidence (inclusion observed in the animal by nasal epithelial type – if inclusions are found in both the respiratory and olfactory epithelium for the same animal at the same level, each finding counts as a separate incidence) of inclusions in animals by level for the olfactory and respiratory epithelium (includes respiratory and transitional epithelium) are:

L1 – Total of 12 incidences. The respiratory epithelium was affected twice as often (Respiratory = 8/12; Olfactory = 4/12). The inclusions were more prevalent in females (Respiratory 6/8; Olfactory 2/4) and changes were primarily observed in the high dose group (10/12).

L2 – Total of 55 incidences. The inclusions were most often located in the olfactory epithelium (32/55). The inclusions observed in the respiratory epithelium were located primarily in the nasal septal region. The inclusions were more prevalent in females in the olfactory epithelium (Females = 19/32; Males = 13/32) and in the males in the respiratory epithelium (Males = 12/23; Females = 11/23). Groups affected in decreasing order of incidence: High dose (34/55) > Mid dose (10/55) > Low dose (9/55) > Control (2/55).

L3 – Total of 96 incidences. The olfactory epithelium was more commonly affected (Olfactory = 72/96; Respiratory = 24/96). The inclusions were most prevalent in females for both epithelial types (Olfactory - Females = 39/72, Olfactory - Males = 33/72; Respiratory - Females = 13/24, Respiratory - Males = 11/24). A majority of the inclusions observed in the respiratory epithelium were located in the nasal septal region with fewer numbers in the mid-lateral meatus (transitional epithelium). Groups affected in decreasing order of incidence: High dose (40/96) > Mid dose (21/96) > Low dose (20/96) > Control (15/96). With the exception of control males, the inclusions in the olfactory epithelium were relatively equally distributed for all groups (HD = 20/72; MD = 18/72; LD = 20/72; Control = 14/72), while inclusions in the respiratory epithelium occurred primarily in the high dose group (20/24). Inclusions in the respiratory epithelium were more commonly observed in the transitional epithelium lining the nasal turbinates and the lateral aspect of the nasal cavity.

L4 – Total of 83 incidences. A majority of the inclusions occurred in the olfactory epithelium (Olfactory = 65/83; Respiratory = 18/83). Groups affected in decreasing order of incidence: High dose (38/83) > Mid dose (17/83) > Low dose (17/83) > Control (11/83). Inclusions in the respiratory epithelium occurred in the high dose group (18/18), and equally affected both genders. Inclusions in the olfactory epithelium for each group: HD = 20/65; MD = 17/65; LD = 17/65; Control = 11/65, and were relatively similar for both genders (Male = 33, Female = 32).

Results of severity by treatment group for each epithelial type are:

Respiratory epithelium – In all treatment groups, a majority of the inclusions occurred in the high dose group (63/73) for all severity category and females were more commonly affected (Female = 39/73; Male = 34/73). See table below for details.

Severity →	Rare	Minimal	Mild	Moderate	Totals
Groups↓					
Control					
Female	2				2
Male					
Low Dose					
Female	1				1
Male					
Mid Dose					
Female	1	2			3
Male	4				4
High Dose					
Female	5	2	15	11	33
Male	2	8	13	7	30
Totals	15	12	28	18	73

Olfactory epithelium – A majority of the inclusions for all treatment groups were rare to minimal (128/173), the more severe changes occurred in the mid and high dose groups (45/173), and inclusions were slightly more prevalent in females (Female = 92/173; Male = 81/173). See table below for details.

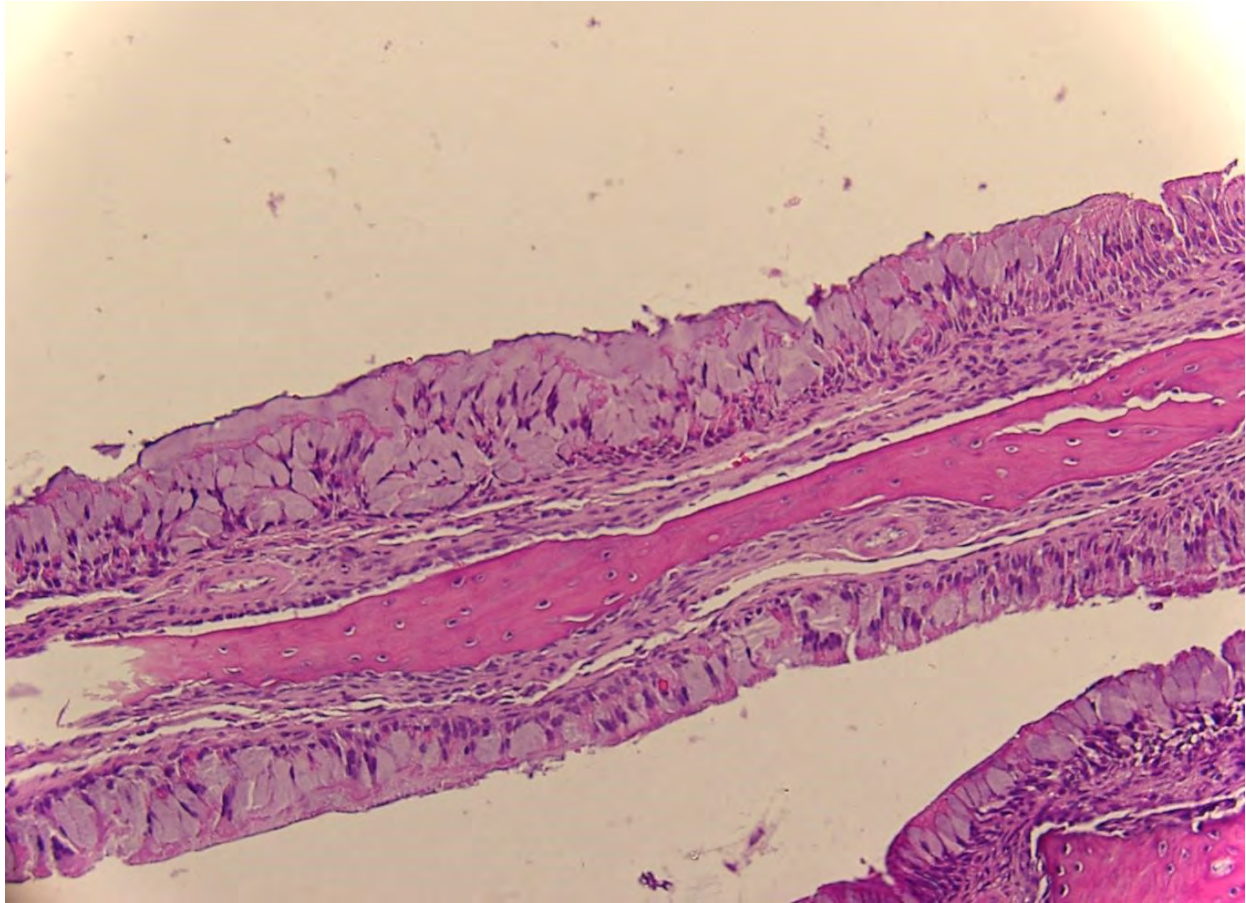
Severity →	Rare	Minimal	Mild	Moderate	Totals
Groups↓					
Control					
Female	13	3			16
Male	9	1			10
Low Dose					
Female	19	5			24
Male	15	7			22
Mid Dose					
Female	15	7			22
Male	10	10			20
High Dose					
Female	2	4	14	10	30
Male	1	7	18	3	29
Totals	84	44	32	13	173

All epithelial types – A larger percentage of the inclusions were rare to minimal (155/246 – 63%), the more severe changes occurred in the mid and high dose groups (91/246 – 37%), and inclusions were slightly more prevalent in females (Female = 131/246; Male = 115/246). See table below for details.

Severity →	Rare	Minimal	Mild	Moderate	Totals
Groups↓					
Control					
Female	15	3			18
Male	9	1			10
Low Dose					
Female	20	5			25
Male	15	7			22
Mid Dose					
Female	16	9			25
Male	14	10			24
High Dose					
Female	7	6	29	21	63
Male	3	15	31	10	59
Totals	99	56	60	31	246

Corpora amylacea (mineral concretions) - is common in the nasal epithelium lining the nasal turbinates. The background lesion was more prevalent and severe in the males in this study; 53% of males were affected in comparison to 47% of females. Also, 66% of the animals with mild changes were male. Severity of the finding ranged from rare to mild with 57% having minimal changes, 26% mild changes and 17% rare. Noted is the fact that the number of animals affected was higher at Level 3 and 4 in the nasal cavity.

Goblet cell hyperplasia - is a common response to mucosal irritation. In this study, 23 animals exhibited the lesion. The change was most commonly observed at Level 2 and 3 of the nasal cavity and was located at the base of the nasal septum or on the tips of the nasal turbinates. The finding was more prevalent in females while the severity between genders was essentially the same. The severity of the lesions ranged from rare to mild. 74% of animals had minimal changes, 17% mild and the remainder is rare.



Goblet cell hyperplasia. Respiratory epithelium, Level 2, Rat 61, High Dose Group. 20X

Minimal inflammatory infiltrates - acute and/or subchronic are common in the nasal mucosa, even on animals not subjected to toxicology studies. Rare acute infiltrates were often observed in the nasal vestibule and ventral meatus, while those in the nasal septum were more often subchronic. The incidence was highest in the control group and the severity of the lesion did not increase with each respectively higher treatment group. Of the 37 affected animals, 57% were males.

Larynx – Larynx was not submitted for histopathological examination for animals in this study.

Trachea – Tissues essentially normal.

Lungs – Occasional lymphoid infiltrates or subpleural aggregates were observed in all study groups. The incidence was rare in the control, low dose and mid dose groups and minimal in the high dose group. Also, the number of animals affected in the mid dose and high dose groups was slightly higher than the control and low dose groups. Mineralization was observed in all groups and the number of affected animals per group was relatively the same. While the degree of mineralization in the high dose group was minimal compared to rare in all other groups, this change is considered a normal background lesion that is common in aging animals. Low numbers of alveolar histiocytes were a common background finding in the rodent lung of all animals on this study. The macrophages are often observed near the peripheral regions of the lung or subpleural. Alveolar hemorrhage was observed in a few rats in each group. Hemorrhage can occur regardless of the method of euthanasia and is considered an agonal event especially with animals that are euthanized by carbon dioxide.

Note: Bronchial lymph node submissions per groups: Control 5/20; Low Dose 2/20; Mid Dose 2/20 and High Dose 0/20.

Interpretation of findings

Nasal Cavity – The cytoplasmic eosinophilic globules (inclusions) that are commonly observed in the nasal epithelium of aging rats can also be induced or exacerbated by irritant chemicals. The epithelial type most commonly affected was the olfactory epithelium (Olfactory epithelium (173/246) > Respiratory epithelium (73/246)). The levels of the nasal cavity with inclusions observed from highest to lowest are: L3 (96/246) > L4 (83/246) > L2 (55/246) > L1 (12/246). The inclusions occurred more frequently in females for both epithelial types (Olfactory - female = 92/173, Olfactory - male = 81/173); (Respiratory - female = 39/73, Respiratory - male = 34/73). The treatment group most severely affected was the high dose group (122/246 – 50%) for both epithelial types (Respiratory = 63/122; Olfactory = 59/122).

Lungs - Generally, a few inflammatory infiltrates are observed in the lungs of Fischer rats and subpleural lymphoid aggregates are considered a focal deficit in the pulmonary clearance mechanism. The slight increase in the number of animals affected in the mid dose and high dose groups and the increase in severity in the high dose group, while minimal, is likely due to increased irritation caused by exposure to the higher concentrations of the test article in those treatment groups. Focal pulmonary mineralization is a frequent incidental finding in 90 day studies. Alveolar histiocytes are considered a common incidental finding that are observed in young and aging rats. The alveolar hemorrhage is a common agonal event that occurs when the animal is euthanized.

Cardiovascular System

Table 2. Cardiovascular lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	High Dose Group
Heart		
Inflammatory infiltrates	F – 3(+); M – 8(+)	F – 8(+); M – 11(+), 1(++)
Degeneration	M – 7(+)	F – 1(+); M – 9(+)
Regeneration	M – 1(+)	
Great Vessels		
Mineralization	M – 1(R), 2(+)	
Cartilaginous metaplasia	M – 2(+)	

M = Male; F = Female; Minimal (+), Mild (++)

Heart – Seven male rats in the control group and nine in the high dose group, along with a female in the high dose group, exhibited spontaneous cardiomyopathy characterized by infiltration of lymphoid cells surrounding degenerative to necrotic cardiomyocytes. One male rat in the high dose group also had vasculitis of a solitary cardiac vessel at the heart base; the cause of the vasculitis was not evident on the section of heart submitted for histopathological examination. The remaining affected rats had minimal myocardial lymphoid infiltrates.

Great Vessels – Cartilaginous foci and mineralization are common findings in rats.

Interpretation of Findings - Cardiomyopathy in rats is a common aging change. Arteritis is occasionally found in rats and is more common in Fischer rats. Myocardial inflammatory infiltrates are also a common finding in older rats. The cardiovascular lesions are not considered to secondary to the test article.

Nervous System

Table 3. Nervous System lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	High Dose Group
Spinal Cord		
Epidermoid cyst		F – 1(+)

M = Male; F = Female; Minimal (+)

Cerebrum - Epidermoid cysts are occasionally observed on the surface of the brain or spinal cord. The cysts originate from embryological remnants of ectoderm and comprised of keratin.

Cerebellum - Essentially normal.

Note: Cerebellum submissions per group: Control 5/20; High Dose 1/20.

Interpretation of findings - The nervous system is essentially normal.

Gastrointestinal System

Table 4. Gastrointestinal lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	High Dose Group
Tongue		
Mineralization	M – 5 (+)	M – 5(+)
Inflammation		M – 1(+)
Stomach		
Squamous cyst	M – 1(+)	
Inflammation		M – 2(+)
Mineralization	F – 1(+); M – 2(+)	M – 1(+)

M = Male; F = Female; Minimal (+)

Tongue – Mineralization is a common aging change observed in all species of rats. The subchronic inflammation observed in the tongue in the high dose male is considered an incidental finding.

Stomach – Squamous cysts are common in the stomach primarily in the region of the limiting ridge and antral mucosa along with inflammatory infiltrates. Mineralization is a common aging change observed in all species of rats.

Interpretation of findings - The changes observed in the gastrointestinal tract are considered common background lesions not related to the test article.

Hepatobiliary System

Table 5. Hepatic lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	High Dose Group
Liver		
Inflammatory infiltrates	F – 10(+); M – 10(+)	F – 9(+); M – 10(+)
Single Cell Necrosis	F – 9(R); M – 10(R)	F – 6(R); M – 10(R)

M = Male; F = Female; Rare (R), Minimal (+)

Liver – The cellular infiltrates are a combination of minimal foci of haemopoiesis and lymphoid infiltrates that can occur in aging animals. The lesions observed are attributed to intestinal exposure to foreign agents. Individual/single cell necrosis (hepatocellular necrosis) may be seen in aging untreated animals as well as animals exposed to toxic agents.

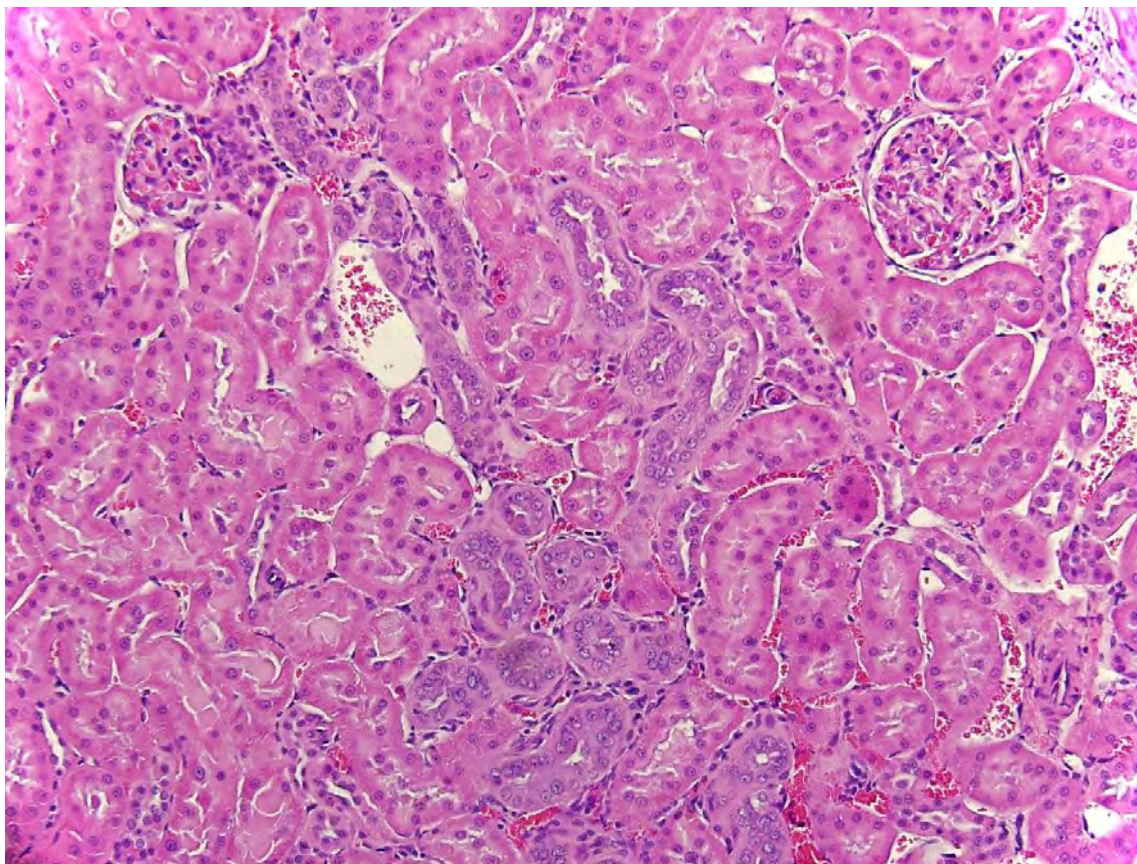
Interpretation of findings - The changes observed in the liver equally affect both the control and high dose groups and are attributed to common aging changes.

Urinary System

Table 6. Renal lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	Low Dose Group	Mid Dose Group	High Dose Group
Kidneys				
Tubular degeneration	M – 1(R), 7(+), 1(++)	F – 1(+) M – 1(+), 8(++)	F – 1(+) M – 4(+), 6(++)	M – 10(++)
Peritubular fibrosis	M – 8(+)	M – 9(+)	F – 1(+) M – 10(+)	M – 10(+)
Periglomerular fibrosis	F – 1(+) M – 1(+), 1(++)	M – 1(R), 4(+)	M – 1(+), 2(++)	F – 3(+); M 9(++)
Inflammation	M – 4(+), 1(++)	F – 2(+) M – 1(R), 2(+), 3(++)	M – 2(+), 3(++)	F – 2(+); M – 9(++)
Hyaline droplets	M – 9(+), 1(++)	M – 6(++)	M – 4(+), 6(++)	M – 10(++)
Mineralization	F – 10(+) M – 9(+), 1(++)	F – 10(+) M – 2(+), 8(++)	F – 10(+) M – 4(+), 6(++)	F – 10(+); M – 10(++)
Hyaline casts		M – 1 (R)		
Tubular proteinosis	F – 10(+) M – 9(+), 1(++)	F – 10(+) M – 2(+), 8(++)	F – 10(+) M – 4(+), 6(++)	F – 10(+); M – 10(++)
Tubular loss w/fibrosis	M – 1(+)			
Urinary Bladder				
Mineralization	M – 1(+)			

M = Male; F = Female; Rare (R), Minimal (+), Mild (++)



Chronic Progressive Glomerulonephropathy (PGN). Basophilic tubules with peritubular Fibrosis, Rat 75, High Dose Group. 20X

Kidneys – All animals exhibit varying degrees of chronic progressive glomerulonephropathy.

Interpretation of findings - An early stage of chronic progressive glomerulonephropathy (PGN), a common age-related degenerative disease, especially in this strain of rat, was a common finding in 100% of the animals in this study; 100% of the males and 23% of the female's exhibit lesions that are advanced beyond the very earliest changes of tubular proteinosis and mineralization. Features of PGN include varying degrees of: peritubular fibrosis of the proximal convoluted tubules, periglomerular fibrosis, tubular ectasia, chronic interstitial nephritis, interstitial fibrosis with stromal collapse, tubular proteinosis and renal tubular mineralization. The severity is minimal in the control group with the exception of six males. In the treatment groups, in general, the number of rats affected and the severity is progressively more severe in a dose dependent manner. The increased severity and incidence of occurrence in all treated groups suggest a test article causal effect.

Reproductive System

Table 7. Reproductive lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	High Dose Group
Testes		
Mineralization		M – 1 (+)
Epididymis		
Inflammatory infiltrates	M – 1(+)	

M = Male; F = Female; Minimal (+)

Interpretation of findings - Testicular mineralization is a common aging change. Infiltrates in the epididymis is an incidental finding. The male reproductive organs are essentially normal.

Special Senses

Table 8. Ocular lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	Mid Dose Group	High Dose Group
Eye			
Mineralization	F – 1(+)		F – 3(+)
Tarsal Gland			
Inflammatory infiltrates	F – 1(++)		
Harderian Gland			
Inflammatory infiltrates	F – 2(+), 1(++)	F – 1(+++); M – 1(+), 1(++)	F – 1(+), 1(+++); M – 1(+)
Cystic degeneration		M – 1(++)	
Lacrimal Gland			
Inflammatory infiltrates			F – 1(++)

M = Male; F = Female; Minimal (+), Mild (++)

Eye – Mineralization is a common aging change in rats. In the control and high dose rats, the mineralization occurred around a single and rarely around two subepithelial, conjunctival glands.

Tarsal Gland, Harderian Gland, Lacrimal Gland – Lymphoid infiltrates are commonly found in aging rats. The cystic degeneration in the male rat in the mid dose group is considered an incidental finding.

Note: Lacrimal gland submissions per group: Control 0/20; High Dose 1/20.

Interpretation of findings - The special sensory lesions are considered common background changes. One female out of 40 rats for the control and high dose groups had the lacrimal gland submitted for histopathological examination, that sample had mild subchronic inflammatory infiltrates and is not clinically significant. The subchronic infiltrates in the females in the mid and high dose groups and the cystic degeneration in the male in the mid dose group in the Harderian gland are incidental findings not attributed to the test article.

Endocrine System

Table 9. Endocrine lesions - Gevo Bio-derived Fuel Subchronic Inhalation Toxicity Study

	Control Group	High Dose Group
Spleen		
Hemosiderosis	F – 10(+); M – 10(+)	F – 10(+); M – 10(+)
Pancreas		
Single cell necrosis	F – 1(+)	F – 1(+); M – 1(+)
Thyroid Gland		
Degeneration	F – 1(+), 1(++)	
Pituitary Gland		
Rathke's Pouch cyst	F – 2(+)	F – 2(+); M – 1(+)
Inflammatory infiltrates	M – 1(+)	
Degeneration	M – 1(+)	

M = Male; F = Female; Minimal (+), Mild (++)

Spleen – Increased hemosiderin in splenic macrophages (hemosiderosis) is a common background change in rats.

Exocrine Pancreas – Apoptotic pancreatic acinar cells (single cell necrosis) are common findings in an aging rat pancreas and are not considered significant.

Thyroid Gland – Degenerative changes in F344 rats, while uncommon, do occasionally occur. The degenerative changes observed in the two female controls, are considered an incidental finding and are not clinically significant.

Note: Thyroid gland submissions per group: Control 1/20; High Dose 0/20.

Parathyroid gland submissions per group: Control 0/20; High Dose 0/20.

Pituitary Gland – Pituitary cysts are very common in aging rats. The acute neutrophilic infiltrates with degeneration in the male control was an incidental finding; the cause of the inflammatory component is considered secondary to cellular degeneration.

Interpretation of findings - The findings in the organs that comprise the endocrine system are common background lesions and are not toxicologically significant.

Comprehensive Interpretation

Nasal Cavity – Lesions in the upper respiratory tract in inhalation studies can exhibit a steep anteroposterior severity gradient. Rats have the ability to reduce their minute volume by at least 15%, and the depression in the respiratory rate, coupled with higher concentrations of an inhaled chemical irritant, can lead to progressively more severe lesions in each successively higher concentration treatment group. Additionally, the location and severity of lesions may be due to the regional deposition of the inhaled chemical in the upper respiratory tract.

In the nasal passages, the type of epithelial lining determines how the epithelium will respond to inhaled irritants. Squamous epithelium that lines the nasal vestibule and ventral meatus is generally resistant to inhaled chemical compounds. Respiratory epithelium is often more sensitive to inhaled irritants; the degree of sensitivity of the mucosa to the chemical, combined with the integrity of the mucociliary apparatus, determines the response to the inhaled chemical. If the irritant is relatively mild and the duration of the exposure is short, goblet cell hypertrophy and hyperplasia and an increase in mucous secretions may be the only change noted. The thicker mucous blanket found in this type of epithelium offers additional protection to airborne irritants. Transitional epithelium may be extremely sensitive to inhaled irritants. The increased sensitivity is due in part to the anteriolateral location, a thinner, slower moving mucous blanket, and a paucity of ciliated cells. Olfactory epithelium is very sensitive to inhaled chemical compounds. The most anterior portion in the dorsal meatus is the area most often affected and the olfactory neurons are extremely sensitive to noxious agents.

Overall, the cytoplasmic eosinophilic globules (inclusions) observed in the nasal cavity, at the four sectioned levels, for all animals most frequently occurred in the olfactory epithelium (Olfactory = 173/246; Respiratory = 73/246). Level 3 had the highest number of inclusion incidences (96/246- 39%) and the highest degree of severity (63/246 – 26%). The highest percentage of incidences for all treatment groups occurred in the high dose group at all levels (122/246 – 50%), and females were more often affected (Females = 131/246; Males = 115/246).

Lungs - The slight increase in pulmonary inflammatory infiltrates in the number of animals in the mid dose and high dose groups combined with the slight increase in severity in the high dose group is suggestive of increased irritation caused by exposure to the higher concentrations of the test article in those treatment groups.

Kidneys – Nephropathy is a spontaneous disease that commonly occurs early in life and progresses to end-stage renal failure. Features of PGN observed in this study included varying degrees of: peritubular fibrosis of the proximal convoluted tubules, periglomerular fibrosis, chronic interstitial nephritis, tubular proteinosis, hyaline droplet nephropathy in the treatment groups and renal tubular mineralization. The disease is more common and prominent in males and is more severe as they age. The cause is multifactorial but protein overload is the most common culprit, with the proximal convoluted tubules being the most common site for this lesion. The number of animals affected and/or severity of the PGN in the treatment groups suggests a cause and effect related to exposure to the test article. Hyaline droplet nephropathy, a feature of PGN, is a term for a morphologic change in the kidneys of rats that can be induced by various chemicals. A possible mechanism of action for the abnormal accumulation of α -2- μ -globulin within the cytoplasmic phagolysosomes of the proximal tubular epithelium is either, binding of the chemical with the α -2- μ -globulin or structural alteration resulting in the inability of the lysosomal enzymes to degrade the protein complex.

Further long term testing of the agent may determine degree of severity or incidence in each gender with prolonged exposure, or withdrawal after prolonged exposure, to assess lesions attributed to the test article.

//signed//

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APPENDIX I. BLOOD CLOTTING PARAMETERS, CLINICAL CHEMISTRY AND HEMATOLOGY

ACRONYMS DEFINED

Blood Clotting Parameters

INR international normalized ratio

PT-P prothrombin time in plasma

Clinical Chemistry Parameters

ALB albumin

ALKP alkaline phosphatase

ALT alanine transaminase

AST aspartate transaminase

BUN blood urea nitrogen

CHOL cholesterol

CK creatine kinase

CREA creatinine

GLOB globulins

GLU glucose

TBIL total bilirubin

TP total protein

TRIG triglycerides

Na⁺ sodium

K⁺ potassium

Cl⁻ chloride

Hematology Parameters

BA basophils

EO eosinophils

HB hemoglobin

HCT hematocrit

LY lymphocytes

MCH mean corpuscular

MCHC mean corpuscular hemoglobin

MCV mean corpuscular volume

MO monocytes

MPV mean platelet volume

NE neutrophils

PLT platelets

RBC red blood cells

RDW red cell distribution width

WBC white blood cells

Blood Clotting Parameters following Exposure to Gevo (bio) ATJ SPK

Male Data

Animal ID	Exposure Group (mg/m3)	PT-P	INR
001	0	31.1	2.4
003	0	35.9	2.8
005	0	37.6	2.9
007	0	35.9	2.8
109	0	28.1	2.2
011	0	35.9	2.8
013	0	35.9	2.8
015	0	31.1	2.4
117	0	37.6	2.9
019	0	32.7	2.5
	AVG	35.54	2.73
	STD DEV	6.275	0.485
061	2000	23.8	1.8
063	2000	18.6	1.4
065	2000	37.6	2.9
135	2000	35.9	2.8
069	2000	x	x
071	2000	39.3	3.0
073	2000	34.3	2.6
075	2000	31.1	2.4
077	2000	35.9	2.8
079	2000	31.1	2.4
	AVG	37.15	2.85
	STD DEV	5.776	0.455
021	200	32.7	2.5
023	200	34.3	2.6
025	200	35.9	2.8
027	200	32.7	2.5
129	200	31.1	2.4
031	200	31.1	2.4
033	200	32.7	2.5
035	200	32.7	2.5
037	200	44.7	3.4
039	200	32.7	2.5
	AVG	37.32	2.87
	STD DEV	3.345	0.250
041	700	x	x
043	700	31.1	2.4
045	700	31.1	2.4
047	700	22.4	1.7
049	700	34.3	2.6
051	700	32.7	2.5
053	700	31.1	2.4
055	700	35.9	2.8
057	700	35.9	2.8
059	700	7.3	0.8
	AVG	42.99	3.31
	STD DEV	22.143	1.721

Female Data

Animal ID	Exposure Group (mg/m3)	PT-P	INR
002	0	34.3	2.6
004	0	39.3	3.0
006	0	39.3	3.0
008	0	41.1	3.2
010	0	39.3	3.0
012	0	35.9	2.8
014	0	21.2	1.6
016	0	37.6	2.9
018	0	39.3	3.0
020	0	28.1	2.2
	AVG	34.18	2.65
	STD DEV	3.221	0.251
062	2000	23.8	1.8
064	2000	34.3	2.6
066	2000	35.9	2.8
068	2000	37.6	2.9
070	2000	42.9	3.3
072	2000	37.6	2.9
074	2000	34.3	2.6
076	2000	39.3	3.0
078	2000	42.9	3.3
080	2000	42.9	3.3
	AVG	31.96	2.46
	STD DEV	6.789	0.536
022	200	31.1	2.4
024	200	39.3	3.0
026	200	39.3	3.0
028	200	34.3	2.6
030	200	39.3	3.0
032	200	35.9	2.8
034	200	39.3	3.0
036	200	35.9	2.8
038	200	35.9	2.8
040	200	42.9	3.3
	AVG	34.06	2.61
	STD DEV	3.992	0.300
042	700	102.2	7.9
044	700	39.3	3.0
046	700	39.3	3.0
048	700	41.1	3.2
050	700	16.2	1.2
052	700	35.9	2.8
054	700	34.3	2.6
056	700	37.6	2.9
058	700	41.1	3.2
060	700	42.9	3.3
	AVG	29.09	2.27
	STD DEV	9.115	0.638

Clinical Chemistry Values for Control Group Rats

gender	animal ID	ALB (g/dL)	ALKP (U/L)	ALT (U/L)	AST (U/L)	BUN (mg/dL)	CHOL (mg/dL)	CK (U/L)	CREA (mg/dL)
male	1	2.8	223	90	150	18	61	14	0.3
female	2	3.1	217	89	101	20	89	5	0.3
male	3	2.7	220	41	81	15	50	58	0.3
female	4	2.7	242	50	68	18	79	39	0.3
male	5	2.5	217	60	76	13	47	82	0.3
female	6	3.1	207	95	85	11	89	33	0.2
male	7	2.4	179	65	70	11	42	24	0.2
female	8	2.8	161	61	71	14	77	27	0.3
male	109	2.6	187	78	100	11	48	59	0.3
female	10	2.9	135	48	89	13	77	47	0.3
male	11	2.9	274	78	80	15	52	139	0.3
female	12	2.9	275	66	83	18	79	36	0.3
male	13	2.8	272	91	79	16	59	95	0.2
female	14	2.9	221	50	77	13	76	106	0.3
male	15	2.7	230	79	88	16	54	98	0.3
female	16	2.9	208	41	58	12	78	159	0.3
male	117	2.6	202	58	75	12	51	37	0.2
female	18	3.1	198	80	53	14	85	167	0.3
male	19	2.5	177	33	57	13	59	85	0.2
female	20	2.7	188	43	84	15	75	59	0.3

gender	animal ID	GLOB (g/dL)	GLU (mg/dL)	TBIL (mg/dL)	TP (g/dL)	TRIG (mg/dL)	Na+ (mmol/L)	K+ (mmol/L)	Cl- (mmol/L)
male	1	2.4	220	0.1	5.2	90	150	1.9	106
female	2	2.2	151	0.1	5.3	45	148	3.6	109
male	3	2.4	160	0.1	5.1	43	154	4.1	111
female	4	2.4	152	0.1	5.1	44	148	3.8	109
male	5	2.6	164	0.1	5.1	72	144	3.7	107
female	6	2.6	159	0.1	5.6	50	150	4.3	110
male	7	2.3	168	0.1	4.7	73	145	4.4	108
female	8	2.5	174	0.1	5.3	30	144	4.3	105
male	109	2.6	175	0.1	5.1	79	152	4.5	107
female	10	2.4	138	0.1	5.2	34	149	4.6	107
male	11	2.5	189	0.1	5.4	101	146	3.9	105
female	12	2.3	144	0.1	5.2	72	146	3.8	107
male	13	2.5	159	0.1	5.3	83	146	4.4	106
female	14	2.3	159	0.1	5.2	31	144	4.8	107
male	15	2.5	160	0.1	5.2	119	146	4.4	107
female	16	2.4	170	0.1	5.3	31	145	4.7	107
male	117	2.6	197	0.1	5.2	85	146	4.1	106
female	18	2.3	190	0.1	5.4	30	140	4.1	107
male	19	2.4	187	0.1	4.9	121	147	4.2	107
female	20	2.5	141	0.1	5.2	43	147	3.8	110

Note: Values in yellow were reported from the VetTest instrument as <0.1 mg/dL

Clinical Chemistry Values for 200 mg/m³ Gevo (bio) ATJ SPK Exposure Group Rats

gender	animal ID	ALB (g/dL)	ALKP (U/L)	ALT (U/L)	AST (U/L)	BUN (mg/dL)	CHOL (mg/dL)	CK (U/L)	CREA (mg/dL)
male	21	2.5	198	105	91	21	46	3	0.3
female	22	2.6	247	74	113	17	77	2	0.3
male	23	2.9	202	55	71	18	57	47	0.3
female	24	3	182	68	107	17	80	7	0.3
male	25	2.9	223	103	62	16	53	26	0.2
female	26	2.7	140	46	63	13	73	9	0.3
male	27	3	174	58	85	13	63	68	0.3
female	28	3	104	78	75	16	87	0	0.3
male	129	2.6	156	57	79	12	55	44	0.3
female	30	2.7	79	47	74	11	86	0	0.3
male	31	2.8	271	70	69	16	56	47	0.3
female	32	3.3	266	71	86	14	82	37	0.2
male	33	2.8	208	53	74	16	50	32	0.3
female	34	3.1	270	63	106	18	82	8	0.3
male	35	3	194	54	77	18	61	7	0.2
female	36	2.9	243	61	77	16	85	33	0.3
male	37	2.8	234	59	70	17	56	48	0.4
female	38	2.9	227	50	71	12	74	55	0.2
male	39	2.9	140	44	72	9	56	18	0.2
female	40	3	112	51	61	10	89	0	0.2

gender	animal ID	GLOB (g/dL)	GLU (mg/dL)	TBIL (mg/dL)	TP (g/dL)	TRIG (mg/dL)	Na+ (mmol/L)	K+ (mmol/L)	Cl- (mmol/L)
male	21	2.3	253	0.1	4.8	51	170	5	119
female	22	2.2	195	0.1	4.8	29	144	4	107
male	23	2.7	174	0.1	5.5	74	147	4.2	107
female	24	2.5	180	0.1	5.5	27	159	4.4	115
male	25	2.6	167	0.1	5.5	91	148	4.7	106
female	26	2.4	150	0.1	5.1	19	148	3.8	109
male	27	2.8	199	0.1	5.9	176	147	4.6	105
female	28	2.4	221	0.2	5.3	47	147	4.1	108
male	129	2.4	180	0.1	5	112	150	4.4	108
female	30	2.5	178	0.1	5.1	38	145	3.6	106
male	31	2.6	177	0.1	5.4	101	150	4.3	109
female	32	2.6	170	0.1	5.9	117	155	3.9	107
male	33	2.3	214	0.1	5.2	97	145	3.9	106
female	34	2.7	162	0.1	5.8	34	148	4.8	108
male	35	2.5	175	0.1	5.5	153	159	4.6	107
female	36	2.5	148	0.1	5.4	39	146	4.1	106
male	37	2.8	164	0.1	5.6	82	155	3.7	104
female	38	2.4	149	0.1	5.3	45	151	4.8	106
male	39	2.5	179	0.1	5.3	122	148	4.1	109
female	40	2.7	149	0.1	5.7	43	146	4.2	108

Note: Values in yellow were reported from the VefTest instrument as <0.1 mg/dL

Clinical Chemistry Values for 700 mg/m³ Gevo (bio) ATJ SPK Exposure Group Rats

gender	animal ID	ALB (g/dL)	ALKP (U/L)	ALT (U/L)	AST (U/L)	BUN (mg/dL)	CHOL (mg/dL)	CK (U/L)	CREA (mg/dL)
male	41	3.4	135	161	240	24	63	30	0.2
female	42	4.1	202			20	88	99	0.5
male	43	2.5	206	88	72	19	50	74	0.3
female	44	2.9	134	72	71	14	78	58	0.3
male	45	2.6	160	54	57	13	45	27	0.3
female	46	2.8	96	24	63	9	78	34	0.3
male	47	2.7	152	63	60	14	51	34	0.3
female	48	2.8	121	41	63	12	76	0	0.3
male	49	2.9	188	71	80	17	54	0	0.2
female	50	2.9	125	74	75	10	77	0	0.2
male	51	2.7	277	59	80	16	49	126	0.3
female	52	3	235	63	66	16	87	70	0.3
male	53	2.7	281	64	81	18	54	75	0.3
female	54	2.8	274	27	75	15	72	25	0.3
male	55	3.3	245	87	83	18	64	239	0.4
female	56	2.7	250	85	122	18	70	54	0.3
male	57	2.8	245	64	101	18	57	103	0.3
female	58	3.1	190	69	59	14	79	34	0.3
male	59	2.7	181	92	119	15	63	54	0.3
female	60	2.9	164	79	59	16	82	21	0.3

gender	animal ID	GLOB (g/dL)	GLU (mg/dL)	TBIL (mg/dL)	TP (g/dL)	TRIG (mg/dL)	Na+ (mmol/L)	K+ (mmol/L)	Cl- (mmol/L)
male	41	2.9	194	1.4	6.2	119	152	6.4	113
female	42	2.2	347	0.4	6.4	187	131		103
male	43	2.3	197	0.1	4.9	53	145	9.4	103
female	44	2.6	143	0.1	5.4	36	146	4.6	109
male	45	2.4	190	0.1	5	56	149	2	108
female	46	2.4	182	0.1	5.2	39	145	4.2	108
male	47	2.4	177	0.1	5	82	145	4.3	108
female	48	2.4	195	0.1	5.1	39	146	4	109
male	49	2.5	188	0.2	5.4	104	153	3.3	108
female	50	2.3	248	0.1	5.1	36	141	5	105
male	51	2.4	195	0.1	5.1	98	146	4.3	104
female	52	2.3	147	0.1	5.3	70	145	4.3	107
male	53	2.7	210	0.1	5.4	96	145	4.4	105
female	54	2.6	165	0.1	5.4	54	152	4.3	106
male	55	2.9	235	0.1	6.2	118	154	2.1	104
female	56	2.4	182	0.1	5.1	30	146	3.9	106
male	57	2.4	149	0.1	5.2	136	145	4.5	108
female	58	2.4	154	0.1	5.5	51	143	4	108
male	59	2.6	187	0.1	5.3	107	145	4.4	107
female	60	2.5	143	0.1	5.4	33	147	4.1	109

Note: Values in yellow were reported from the VetTest instrument as <0.1 mg/dL; Red cells indicate missing values

Clinical Chemistry Values for 2000 mg/m³ Gevo (bio) ATJ SPK Exposure Group Rats

gender	animal ID	ALB (g/dL)	ALKP (U/L)	ALT (U/L)	AST (U/L)	BUN (mg/dL)	CHOL (mg/dL)	CK (U/L)	CREA (mg/dL)
male	61	2.5	242	69	82	17	48	5	0.3
female	62	3	240	48	74	15	74	3	0.3
male	63	2.2	176	20	69	16	43	55	0.2
female	64	2.8	243	50	72	19	77	1	0.3
male	65	2.8	184	63	68	14	57	19	0.3
female	66	2.8	193	63	64	14	84	26	0.2
male	135	2.7	147	78	74	16	58	27	0.3
female	68	2.8	166	76	65	19	70	174	0.3
male	69	2.8	122	58	75	12	48	393	0.2
female	70	2.7	168	61	47	10	71	32	0.2
male	71	2.9	267	57	89	18	63	44	0.3
female	72	3.2	149	42	65	17	89	69	0.2
male	73	3.1	199	141	253	21	54	153	0.2
female	74	3.2	216	77	91	22	81	0	0.2
male	75	3	191	57	94	17	61	20	0.3
female	76	2.9	200	46	67	16	76	0	0.2
male	77	2.8	210	51	69	15	57	3	0.3
female	78	3.2	220	54	97	17	79	91	0.2
male	79	2.9	159	58	93	16	63	279	0.3
female	80	2.7	168	72	62	11	77	8	0.3

gender	animal ID	GLOB (g/dL)	GLU (mg/dL)	TBIL (mg/dL)	TP (g/dL)	TRIG (mg/dL)	Na+ (mmol/L)	K+ (mmol/L)	Cl- (mmol/L)
male	61	2.5	162	0.1	5	76	145	4.2	109
female	62	2.6	166	0.1	5.5	37	147	3.6	109
male	63	2.3	198	0.1	4.5	65	145	4	108
female	64	2.3	184	0.1	5.1	28	145	3.7	104
male	65	2.7	173	0.1	5.6	93	147	4.4	106
female	66	2.2	152	0.1	5.1	35	149	4.1	107
male	135	2.5	220	0.1	5.3	108	144	3.9	108
female	68	2.1	187	0.1	4.9	23	154	3.8	111
male	69	2.7	206	0.1	5.5	156	146	4.2	108
female	70	2.4	148	0.1	5.1	40	146	4.6	110
male	71	2.8	185	0.1	5.7	92	148	3.9	106
female	72	2.7	148	0.1	5.9	44	140	4.2	107
male	73	2.8	160	0.3	5.9	109	146	5.3	107
female	74	2.6	183	0.1	5.8	58	147	4.2	108
male	75	2.7	189	0.1	5.7	176	149	2.2	105
female	76	2.3	153	0.1	5.3	44	150	4	108
male	77	2.4	183	0.1	5.1	137	144	4.4	107
female	78	2.4	143	0.1	5.6	31	149	4.1	105
male	79	2.7	211	0.1	5.5	147	145	4.6	106
female	80	2.3	130	0.1	5	33	156	4.3	109

Note: Values in yellow were reported from the VetTest instrument as <0.1 mg/dL; Red cells indicate missing values

Hematology Values for Male Rats following Exposure to Gevo (bio) ATJ SPK

Sample ID	WBC	NE#	LY#	MO#	EO#	BA#	NE%	LY%	MO%	EO%	BA%	RBC	HB	HCT	MCV	MCH	MCHC	RDW	PLT	MPV
C-001-1	7.14	2.00	4.38	0.75	0.00	0.00	28.08	61.39	10.53	0.00	0.00	9.52	17.70	50.20	52.70	18.60	35.30	16.60	606.00	6.90
C-001-2	7.10	1.96	3.82	1.32	0.00	0.00	27.58	53.78	18.64	0.00	0.00	9.27	17.70	48.20	52.00	19.10	36.70	17.30	630.00	7.10
C-001-3	7.12	1.98	4.10	1.04	0.00	0.00	27.83	57.59	14.59	0.00	0.00	9.40	17.70	49.20	52.35	18.85	36.00	16.95	618.00	7.00
L-021-1	6.76	2.21	3.77	0.77	0.01	0.00	32.71	55.71	11.46	0.12	0.00	9.06	16.80	47.00	51.90	18.50	35.70	16.90	732.00	7.00
L-021-2	6.76	1.91	4.00	0.84	0.01	0.00	28.24	59.20	12.44	0.12	0.00	9.00	17.20	46.40	51.60	19.10	37.10	16.90	685.00	6.90
L-021-3	6.76	2.06	3.89	0.81	0.01	0.00	30.48	57.46	11.95	0.12	0.00	9.03	17.00	46.70	51.75	18.80	36.40	16.90	708.50	6.95
H-061-1	6.94	2.37	3.49	1.06	0.01	0.00	34.22	50.30	15.34	0.13	0.00	9.18	17.60	47.90	52.20	19.20	36.70	16.80	653.00	6.80
H-061-2	6.88	2.47	3.51	0.84	0.06	0.00	35.87	51.00	12.26	0.87	0.00	9.11	17.50	47.30	51.90	19.20	37.00	17.20	634.00	6.70
H-061-3	6.91	2.42	3.50	0.95	0.04	0.00	35.05	50.65	13.80	0.50	0.00	9.15	17.55	47.60	52.05	19.20	36.85	17.00	643.50	6.75
C-003-1	6.22	2.04	3.57	0.59	0.02	0.00	32.84	57.32	9.55	0.29	0.00	9.52	18.40	50.50	53.00	19.30	36.40	16.60	638.00	7.10
C-003-2	5.94	2.28	2.84	0.79	0.02	0.00	38.42	47.89	13.32	0.29	0.08	9.31	18.60	49.10	52.70	20.00	37.90	16.70	671.00	7.10
C-003-3	6.08	2.16	3.21	0.69	0.02	0.00	35.63	52.61	11.44	0.29	0.04	9.42	18.50	49.80	52.85	19.65	37.15	16.65	654.50	7.10
M-043-1	7.24	2.18	4.23	0.83	0.01	0.00	30.06	58.38	11.46	0.09	0.00	9.34	17.30	49.40	52.90	18.50	35.00	16.90	647.00	7.00
M-043-2	7.06	2.12	4.14	0.79	0.02	0.00	29.96	58.58	11.22	0.23	0.00	9.45	18.30	50.60	53.50	19.40	36.20	16.50	670.00	6.90
M-043-3	7.15	2.15	4.19	0.81	0.02	0.00	30.01	58.48	11.34	0.16	0.00	9.40	17.80	50.00	53.20	18.95	35.60	16.70	658.50	6.95
L-023-1	7.62	2.71	4.21	0.67	0.02	0.00	35.56	55.30	8.84	0.29	0.00	9.67	17.70	50.20	51.90	18.30	35.30	17.30	619.00	7.10
L-023-2	7.58	2.63	3.95	0.97	0.03	0.00	34.75	52.14	12.77	0.35	0.00	9.32	17.90	47.60	51.10	19.20	37.60	17.40	646.00	6.90
L-023-3	7.60	2.67	4.08	0.82	0.03	0.00	35.16	53.72	10.81	0.32	0.00	9.50	17.80	48.90	51.50	18.75	36.45	17.35	632.50	7.00
H-063-1	7.30	1.63	4.80	0.86	0.01	0.00	22.32	65.69	11.83	0.09	0.06	9.46	17.30	49.40	52.20	18.30	35.00	17.50	625.00	6.80
H-063-2	7.48	1.73	4.60	1.13	0.01	0.00	23.17	61.55	15.16	0.07	0.06	9.37	18.40	49.40	52.70	19.60	37.20	16.60	619.00	6.60
H-063-3	7.39	1.68	4.70	1.00	0.01	0.00	22.75	63.62	13.50	0.08	0.06	9.42	17.85	49.40	52.45	18.95	36.10	17.05	622.00	6.70
C-005-1	6.96	1.82	4.29	0.85	0.00	0.00	26.12	61.62	12.26	0.00	0.00	9.12	17.10	47.80	52.40	18.80	35.80	17.30	689.00	7.30
C-005-2	6.94	1.83	4.00	1.09	0.02	0.00	26.38	57.59	15.74	0.23	0.07	9.33	18.80	48.90	52.40	20.20	38.40	17.40	601.00	6.90
C-005-3	6.95	1.83	4.15	0.97	0.01	0.00	26.25	59.61	14.00	0.12	0.04	9.23	17.95	48.35	52.40	19.50	37.10	17.35	645.00	7.10
M-045-1	8.30	2.06	5.29	0.95	0.00	0.00	24.84	63.70	11.45	0.01	0.00	9.64	17.80	50.50	52.40	18.50	35.20	16.40	724.00	7.10
M-045-2	8.96	2.36	5.69	0.91	0.01	0.00	26.29	63.45	10.12	0.11	0.04	9.56	18.90	50.10	52.40	19.80	37.70	17.00	699.00	6.90
M-045-3	8.63	2.21	5.49	0.93	0.01	0.00	25.57	63.58	10.79	0.06	0.02	9.60	18.35	50.30	52.40	19.15	36.45	16.70	711.50	7.00
L-025-1	7.12	2.02	4.26	0.84	0.01	0.00	28.40	59.77	11.73	0.10	0.00	9.86	18.30	50.30	51.00	18.60	36.40	17.50	659.00	6.80
L-025-2	7.34	1.92	5.00	0.42	0.00	0.00	26.15	68.17	5.67	0.00	0.00	9.51	18.30	48.80	51.30	19.20	37.50	17.40	637.00	6.90
L-025-3	7.23	1.97	4.63	0.63	0.01	0.00	27.28	63.97	8.70	0.05	0.00	9.69	18.30	49.55	51.15	18.90	36.95	17.45	648.00	6.85
H-065-1	9.36	2.84	5.38	1.13	0.00	0.00	30.33	57.51	12.10	0.01	0.05	9.44	17.50	50.20	53.20	18.50	34.90	16.90	685.00	6.90
H-065-2	9.14	2.72	5.36	1.05	0.01	0.00	29.74	58.65	11.47	0.09	0.05	9.26	17.20	49.80	53.80	18.60	34.50	16.40	761.00	7.20
H-065-3	9.25	2.78	5.37	1.09	0.01	0.00	30.04	58.08	11.79	0.05	0.05	9.35	17.35	50.00	53.50	18.55	34.70	16.65	723.00	7.05
C-007-1	8.18	2.35	4.94	0.88	0.01	0.00	28.73	60.41	10.75	0.12	0.00	9.14	16.90	48.80	53.40	18.50	34.60	16.10	721.00	6.90
C-007-2	7.96	2.05	5.10	0.81	0.00	0.00	25.74	64.07	10.17	0.01	0.00	9.15	16.70	49.30	53.90	18.30	33.90	16.00	726.00	6.70
C-007-3	8.07	2.20	5.02	0.85	0.01	0.00	27.24	62.24	10.46	0.07	0.00	9.15	16.80	49.05	53.65	18.40	34.25	16.05	723.50	6.80
M-047-1	8.80	2.08	5.57	1.11	0.03	0.01	23.63	63.25	12.65	0.37	0.11	9.20	16.70	49.10	53.40	18.20	34.00	16.10	677.00	7.40
M-047-2	8.66	2.06	5.89	0.69	0.01	0.01	23.75	68.05	7.98	0.11	0.11	9.75	17.30	51.70	53.00	17.70	33.50	16.90	671.00	6.90
M-047-3	8.73	2.07	5.73	0.90	0.02	0.01	23.69	65.65	10.32	0.24	0.11	9.48	17.00	50.40	53.20	17.95	33.75	16.50	674.00	7.15
L-027-1	7.50	2.10	4.86	0.54	0.00	0.00	27.96	64.78	7.26	0.01	0.00	9.15	16.80	47.90	52.40	18.40	35.10	16.00	689.00	7.30
L-027-2	7.50	2.11	5.02	0.33	0.02	0.01	28.15	66.99	4.42	0.32	0.13	9.58	17.60	51.10	53.30	18.40	34.40	16.90	700.00	7.50
L-027-3	7.50	2.11	4.94	0.44	0.01	0.01	28.06	65.89	5.84	0.17	0.07	9.37	17.20	49.50	52.85	18.40	34.75	16.45	694.50	7.40
H-135-1	8.22	2.65	4.91	0.66	0.00	0.00	32.19	59.71	8.04	0.06	0.00	9.45	17.10	49.90	52.80	18.10	34.30	16.60	738.00	7.30
H-135-2	7.98	2.45	4.81	0.72	0.00	0.00	30.75	60.27	8.99	0.00	0.00	9.32	17.10	49.30	52.90	18.30	34.70	16.30	668.00	7.10
H-135-3	8.10	2.55	4.86	0.69	0.00	0.00	31.47	59.99	8.52	0.03	0.00	9.39	17.10	49.60	52.85	18.20	34.50	16.45	703.00	7.20
C-109-1	7.62	1.55	5.42	0.64	0.02	0.00	20.33	71.11	8.36	0.21	0.00	9.34	17.30	48.90	52.40	18.50	35.40	16.00	673.00	7.10
C-109-2	7.72	1.83	5.37	0.52	0.00	0.00	23.66	69.50	6.79	0.06	0.00	9.47	17.50	49.80	52.60	18.50	35.10	16.80	602.00	6.90
C-109-3	7.67	1.69	5.40	0.58	0.01	0.00	22.00	70.31	7.58	0.14	0.00	9.41	17.40	49.35	52.50	18.50	35.25	16.40	637.50	7.00
M-049-1	7.14	2.38	4.24	0.51	0.01	0.00	33.34	59.39	7.19	0.09	0.00	9.23	17.70	50.00	54.20	19.20	35.40	16.00	698.00	7.40
M-049-2	7.06	2.25	4.28	0.51	0.02	0.00	31.84	60.62	7.28	0.26	0.00	9.17	16.80	48.40	52.80	18.30	34.70	16.90	701.00	7.40
M-049-3	7.10	2.32	4.26	0.51	0.02	0.00	32.59	60.01	7.24	0.18	0.00	9.20	17.25	49.20	53.50	18.75	35.05	16.45	699.50	7.40
L-129-1	6.98	2.03	4.28	0.66	0.00	0.00	29.09	61.35	9.49	0.07	0.00	9.43	16.90	49.70	52.70	17.90	34.00	16.00	650.00	7.40
L-129-2	6.86	2.18	4.09	0.57	0.01	0.00	31.79	59.68	8.37	0.15	0.00	9.86	17.40	51.50	52.20	17.60	33.80	16.10	740.00	7.10
L-129-3	6.92	2.11	4.19	0.62	0.01	0.00	30.44	60.52	8.93	0.11	0.00	9.65	17.15	50.60	52.45	17.75	33.90	16.05	695.00	7.25
H-069-1	8.78	1.98	5.98	0.83	0.00	0.00	22.51	68.07	9.42	0.00	0.00	9.31	17.00	47.90	51.50	18.30	35.50	17.30	723.00	7.20
H-069-2	8.46	2.11	5.70	0.63	0.01	0.01	24.93	67.36	7.48	0.17	0.06	9.14	16.30	47.90	52.40	17.80	34.00	16.80	798.00	7.40
H-069-3	8.62	2.05	5.84	0.73	0.01	0.01	23.72	67.72	8.45	0.09	0.03	9.23	16.65	47.90	51.95	18.05	34.75	17.05	760.50	7.30
M-051-1	7.62	2.09	4.66	0.85	0.01	0.00	27.45	61.18	11.16	0.14	0.06	9.58	17.90	49.00	51.10	18.70	36.50	18.00	643.00	6.50

Sample ID	WBC	NE#	LY#	MO#	EO#	BA#	NE%	LY%	MO%	EO%	BA%	RBC	HB	HCT	MCV	MCH	MCHC	RDW	PLT	MPV
M-051-2	8.04	2.06	5.18	0.78	0.01	0.01	25.61	64.41	9.68	0.18	0.12	9.88	18.50	51.30	51.90	18.70	36.10	17.30	566.00	6.40
M-051-3	7.83	2.08	4.92	0.82	0.01	0.01	26.53	62.80	10.42	0.16	0.09	9.73	18.20	50.15	51.50	18.70	36.30	17.65	604.50	6.45
C-011-1	6.10	1.77	3.83	0.50	0.00	0.00	28.99	62.77	8.17	0.06	0.00	9.78	18.20	52.20	53.40	18.60	34.90	17.20	684.00	6.90
C-011-2	5.78	1.79	3.53	0.46	0.00	0.00	31.01	61.12	7.88	0.00	0.00	9.11	17.70	48.60	53.30	19.40	36.40	16.50	756.00	7.20
C-011-3	5.94	1.78	3.68	0.48	0.00	0.00	30.00	61.95	8.03	0.03	0.00	9.45	17.95	50.40	53.35	19.00	35.65	16.85	720.00	7.05
H-071-1	6.82	2.16	3.88	0.75	0.03	0.00	31.61	56.93	11.03	0.37	0.07	9.53	18.20	50.90	53.40	19.10	35.80	16.50	650.00	6.80
H-071-2	6.66	2.17	3.25	1.23	0.02	0.00	32.58	48.73	18.46	0.23	0.00	9.34	17.60	50.20	53.70	18.80	35.10	16.10	674.00	6.80
H-071-3	6.74	2.17	3.57	0.99	0.03	0.00	32.10	52.83	14.75	0.30	0.04	9.44	17.90	50.55	53.55	18.95	35.45	16.30	662.00	6.80
L-031-1	6.90	1.97	4.15	0.78	0.00	0.00	28.52	60.13	11.28	0.00	0.06	9.52	17.30	50.30	52.80	18.20	34.40	16.60	666.00	6.80
L-031-2	7.00	2.00	4.27	0.72	0.00	0.00	28.54	61.04	10.35	0.01	0.07	9.63	16.70	52.10	54.10	17.30	32.10	16.30	630.00	6.70
L-031-3	6.95	1.99	4.21	0.75	0.00	0.00	28.53	60.59	10.82	0.01	0.07	9.58	17.00	51.20	53.45	17.75	33.25	16.45	648.00	6.75
M-053-1	6.46	1.90	3.64	0.87	0.05	0.01	29.37	56.40	13.43	0.73	0.08	9.17	16.90	48.50	52.90	18.40	34.80	16.60	685.00	6.50
M-053-2	6.62	1.96	4.02	0.64	0.00	0.00	29.57	60.72	9.68	0.03	0.00	9.07	17.20	48.60	53.60	19.00	35.40	16.10	611.00	6.50
M-053-3	6.54	1.93	3.83	0.76	0.03	0.01	29.47	58.56	11.56	0.38	0.04	9.12	17.05	48.55	53.25	18.70	35.10	16.35	648.00	6.50
C-013-1	4.68	1.28	3.07	0.30	0.01	0.00	27.38	65.70	6.50	0.31	0.10	9.45	17.10	50.70	53.70	18.10	33.70	15.90	665.00	6.60
C-013-2	4.74	1.41	2.71	0.62	0.01	0.00	29.67	57.11	12.99	0.23	0.00	9.29	17.40	50.20	54.00	18.70	34.70	16.00	612.00	6.60
C-013-3	4.71	1.35	2.89	0.46	0.01	0.00	28.53	61.41	9.75	0.27	0.05	9.37	17.25	50.45	53.85	18.40	34.20	15.95	638.50	6.60
H-073-1	8.12	3.32	3.89	0.89	0.02	0.00	40.87	47.88	11.01	0.24	0.00	9.83	18.00	52.40	53.30	18.30	34.40	16.10	650.00	6.80
H-073-2	7.98	3.39	4.08	0.51	0.00	0.00	42.53	51.09	6.34	0.04	0.00	9.89	18.10	53.10	53.70	18.30	34.10	16.10	695.00	6.60
H-073-3	8.05	3.36	3.99	0.70	0.01	0.00	41.70	49.49	8.68	0.14	0.00	9.86	18.05	52.75	53.50	18.30	34.25	16.10	672.50	6.70
L-033-1	7.30	2.56	3.84	0.90	0.01	0.00	35.03	52.57	12.33	0.07	0.00	9.52	17.20	50.60	53.10	18.10	34.00	16.10	707.00	6.90
L-033-2	7.30	2.73	4.03	0.53	0.01	0.00	37.37	55.21	7.29	0.12	0.00	9.06	17.20	47.90	52.90	19.00	35.90	16.60	705.00	6.80
L-033-3	7.30	2.65	3.94	0.72	0.01	0.00	36.20	53.89	9.81	0.10	0.00	9.29	17.20	49.25	53.00	18.55	34.95	16.35	706.00	6.85
M-055-1	7.62	2.27	4.77	0.56	0.01	0.01	29.85	62.56	7.32	0.13	0.12	9.57	17.10	50.30	52.60	17.90	34.00	16.30	687.00	6.90
M-055-2	7.26	2.20	4.49	0.56	0.00	0.00	30.32	61.91	7.77	0.00	0.00	9.69	18.10	50.90	52.50	18.70	35.60	16.30	748.00	6.80
M-055-3	7.44	2.24	4.63	0.56	0.01	0.01	30.09	62.24	7.55	0.07	0.06	9.63	17.60	50.60	52.55	18.30	34.80	16.30	717.50	6.85
C-015-1	6.46	1.99	3.95	0.51	0.02	0.00	30.81	61.09	7.86	0.24	0.00	8.64	17.20	46.70	54.10	19.90	36.80	15.90	565.00	7.00
C-015-2	6.60	2.01	3.98	0.56	0.03	0.00	30.53	60.36	8.54	0.50	0.07	9.22	17.20	50.10	54.30	18.70	34.30	15.90	619.00	6.90
C-015-3	6.53	2.00	3.97	0.54	0.03	0.00	30.67	60.73	8.20	0.37	0.04	8.93	17.20	48.40	54.20	19.30	35.55	15.90	592.00	6.95
H-075-1	7.76	2.46	4.71	0.56	0.03	0.00	31.74	60.67	7.22	0.36	0.00	8.76	16.30	46.40	53.00	18.60	35.10	16.30	656.00	6.50
H-075-2	7.74	2.43	4.89	0.42	0.01	0.00	31.35	63.12	5.40	0.13	0.00	9.07	16.50	48.00	52.90	18.20	34.40	16.00	736.00	6.60
H-075-3	7.75	2.45	4.80	0.49	0.02	0.00	31.55	61.90	6.31	0.25	0.00	8.92	16.40	47.20	52.95	18.40	34.75	16.15	696.00	6.55
L-035-1	7.80	2.89	4.28	0.62	0.00	0.00	37.10	54.85	7.95	0.04	0.06	9.57	17.00	50.50	52.80	17.80	33.70	16.30	743.00	6.90
L-035-2	7.94	2.87	4.28	0.78	0.00	0.00	36.19	53.95	9.80	0.06	0.00	9.89	17.80	52.10	52.70	18.00	34.20	16.30	751.00	7.00
L-035-3	7.87	2.88	4.28	0.70	0.00	0.00	36.65	54.40	8.88	0.05	0.03	9.73	17.40	51.30	52.75	17.90	33.95	16.30	747.00	6.95
M-057-1	7.50	1.86	5.11	0.53	0.00	0.00	24.81	68.17	7.01	0.00	0.00	9.67	18.00	51.90	53.70	18.60	34.70	15.70	632.00	6.30
M-057-2	7.62	1.75	5.12	0.75	0.00	0.00	22.95	67.13	9.89	0.02	0.00	9.78	18.50	52.50	53.70	18.90	35.20	16.40	713.00	6.60
M-057-3	7.56	1.81	5.12	0.64	0.00	0.00	23.88	67.65	8.45	0.01	0.00	9.73	18.25	52.20	53.70	18.75	34.95	16.05	672.50	6.45
C-117-1	8.34	1.96	5.85	0.51	0.02	0.00	23.52	70.15	6.13	0.19	0.00	9.41	17.70	49.90	53.00	18.80	35.50	16.90	628.00	6.80
C-117-2	8.40	1.71	6.07	0.61	0.01	0.00	20.36	72.31	7.21	0.12	0.00	9.53	17.00	51.10	53.60	17.80	33.30	16.10	641.00	6.90
C-117-3	8.37	1.84	5.96	0.56	0.02	0.00	21.94	71.23	6.67	0.16	0.00	9.47	17.35	50.50	53.30	18.30	34.40	16.50	634.50	6.85
H-077-1	7.42	1.88	4.92	0.62	0.01	0.00	25.28	66.26	8.36	0.10	0.00	9.42	17.00	50.30	53.40	18.00	33.80	16.50	648.00	7.00
H-077-2	7.62	1.86	5.18	0.58	0.00	0.00	24.37	67.97	7.67	0.00	0.00	9.52	17.00	50.60	53.20	17.90	33.60	16.20	698.00	6.70
H-077-3	7.52	1.87	5.05	0.60	0.01	0.00	24.83	67.12	8.02	0.05	0.00	9.47	17.00	50.45	53.30	17.95	33.70	16.35	673.00	6.85
L-037-1	6.52	1.66	4.19	0.67	0.00	0.00	25.42	64.25	10.30	0.03	0.00	9.69	17.00	49.40	51.00	17.50	34.40	17.50	649.00	6.70
L-037-2	6.58	1.62	4.37	0.57	0.02	0.00	24.67	66.44	8.67	0.23	0.00	9.75	16.10	50.30	51.60	16.50	32.00	17.00	655.00	6.60
L-037-3	6.55	1.64	4.28	0.62	0.01	0.00	25.05	65.35	9.49	0.13	0.00	9.72	16.55	49.85	51.30	17.00	33.20	17.25	652.00	6.65
M-059-1	7.16	1.49	5.38	0.28	0.01	0.00	20.87	75.13	3.87	0.12	0.00	8.96	16.40	48.10	53.70	18.30	34.10	15.70	163.00	8.80
M-059-2	7.14	1.32	5.37	0.43	0.02	0.00	18.46	75.21	6.01	0.25	0.07	9.32	16.90	50.30	54.00	18.10	33.60	15.90	212.00	8.20
M-059-3	7.15	1.41	5.38	0.36	0.02	0.00	19.67	75.17	4.94	0.19	0.04	9.14	16.65	49.20	53.85	18.20	33.85	15.80	187.50	8.50
C-019-1	7.42	1.66	5.02	0.74	0.00	0.00	22.37	67.67	9.95	0.01	0.00	8.93	16.90	49.00	54.90	18.90	34.50	15.30	586.00	7.20
C-019-2	7.26	1.58	5.29	0.39	0.00	0.00	21.81	72.83	5.34	0.01	0.00	9.07	16.60	49.90	55.00	18.30	33.30	14.90	543.00	6.50
C-019-3	7.34	1.62	5.16	0.57	0.00	0.00	22.09	70.25	7.65	0.01	0.00	9.00	16.75	49.45	54.95	18.60	33.90	15.10	564.50	6.85
H-079-1	7.88	2.24	4.97	0.66	0.01	0.01	28.38	63.03	8.35	0.18	0.08	9.29	16.20	50.70	54.60	17.40	32.00	16.20	662.00	6.70
H-079-2	8.10	2.09	5.26	0.74	0.02	0.00	25.80	64.89	9.10	0.21	0.00	9.32	17.10	50.40	54.10	18.30	33.90	15.30	719.00	7.00
H-079-3	7.99	2.17	5.12	0.70	0.02	0.01	27.09	63.96	8.73	0.20	0.04	9.31	16.65	50.55	54.35	17.85	32.95	15.75	690.50	6.85
L-039-1	7.52	2.01	4.83	0.66	0.02	0.00	26.68	64.27	8.79	0.26	0.00	9.56	17.60	51.00	53.30	18.40	34.50	16.80	615.00	6.80
L-039-2	7.44	1.84	4.82	0.77	0.02	0.00	24.68	64.78	10.29	0.25	0.00	9.78	17.20	53.00	54.20	17.60	32.50	16.30	772.00	7.00
L-039-3	7.48	1.93	4.83	0.72	0.02	0.00	25.68	64.53	9.54	0.26	0.00	9.67	17.40	52.00	53.75	18.00	33.50	16.55	693.50	6.90

Note: Duplicate

Hematology Values for Female Rats following Exposure to Gevo (bio) ATJ SPK

Sample ID	WBC	NE#	LY#	MO#	EO#	BA#	NE%	LY%	MO%	EO%	BA%	RBC	HB	HCT	MCV	MCH	MCHC	RDW	PLT	MPV
L-022-1	4.92	0.85	3.23	0.85	0.00	0.00	17.20	65.59	17.21	0.00	0.00	8.54	17.20	49.60	58.10	20.10	34.70	14.20	594.00	6.40
L-022-2	5.14	0.78	3.54	0.81	0.00	0.00	15.21	68.91	15.79	0.09	0.00	8.12	16.90	47.60	58.60	20.80	35.50	14.40	578.00	6.30
L-022-3	5.03	0.82	3.39	0.83	0.00	0.00	16.21	67.25	16.50	0.05	0.00	8.33	17.05	48.60	58.35	20.45	35.10	14.30	586.00	6.35
H-062-1	6.68	1.55	4.28	0.79	0.05	0.02	23.18	64.00	11.78	0.81	0.23	7.99	16.50	45.90	57.50	20.70	35.90	14.60	430.00	6.50
H-062-2	6.80	1.34	4.61	0.79	0.03	0.02	19.76	67.76	11.62	0.51	0.35	8.09	16.70	46.80	57.80	20.60	35.70	14.20	486.00	6.50
H-062-3	6.74	1.45	4.45	0.79	0.04	0.02	21.47	65.88	11.70	0.66	0.29	8.04	16.60	46.35	57.65	20.65	35.80	14.40	458.00	6.50
C-002-1	5.56	1.11	3.61	0.83	0.01	0.00	19.97	64.93	14.87	0.23	0.00	8.18	16.50	47.80	58.40	20.20	34.50	14.80	471.00	6.60
C-002-2	5.32	1.15	3.56	0.61	0.01	0.00	21.54	66.87	11.43	0.15	0.00	8.05	16.50	46.90	58.20	20.50	35.20	14.50	515.00	6.60
C-002-3	5.44	1.13	3.59	0.72	0.01	0.00	20.76	65.90	13.15	0.19	0.00	8.12	16.50	47.35	58.30	20.35	34.85	14.65	493.00	6.60
M-042-1	4.70	2.16	1.62	0.86	0.04	0.02	45.86	34.50	18.30	0.83	0.51	8.91	18.60	50.90	57.10	20.90	36.50	14.90	860.00	8.20
M-042-2	4.72	2.16	1.81	0.68	0.06	0.01	45.76	38.45	14.33	1.30	0.16	9.19	18.30	52.70	57.30	19.90	34.70	14.60	851.00	8.10
M-042-3	4.71	2.16	1.72	0.77	0.05	0.02	45.81	36.48	16.32	1.07	0.34	9.05	18.45	51.80	57.20	20.40	35.60	14.75	855.50	8.15
L-024-1	5.26	1.13	3.48	0.65	0.00	0.00	21.43	66.17	12.32	0.08	0.00	8.53	16.70	48.50	56.80	19.60	34.40	15.40	591.00	6.50
L-024-2	5.12	0.96	3.45	0.70	0.01	0.00	18.67	67.45	13.60	0.28	0.00	8.54	16.70	49.20	57.60	19.60	33.90	14.90	629.00	6.40
L-024-3	5.19	1.05	3.47	0.68	0.01	0.00	20.05	66.81	12.96	0.18	0.00	8.54	16.70	48.85	57.20	19.60	34.15	15.15	610.00	6.45
H-064-1	5.74	1.08	4.10	0.54	0.01	0.00	18.89	71.47	9.47	0.17	0.00	7.76	15.70	45.20	58.30	20.20	34.70	14.40	629.00	6.60
H-064-2	5.86	1.15	3.98	0.73	0.00	0.00	19.68	67.89	12.43	0.00	0.00	7.54	15.40	44.30	58.80	20.40	34.80	14.00	624.00	6.70
H-064-3	5.80	1.12	4.04	0.64	0.01	0.00	19.29	69.68	10.95	0.09	0.00	7.65	15.55	44.75	58.55	20.30	34.75	14.20	626.50	6.65
C-004-1	6.30	1.13	3.98	1.19	0.00	0.00	17.89	63.25	18.86	0.00	0.00	8.40	16.70	48.40	57.60	19.90	34.50	15.70	671.00	6.50
C-004-2	6.10	1.02	4.12	0.96	0.00	0.00	16.64	67.58	15.79	0.00	0.00	8.53	16.70	49.60	58.20	19.60	33.70	15.40	711.00	6.80
C-004-3	6.20	1.08	4.05	1.08	0.00	0.00	17.27	65.42	17.33	0.00	0.00	8.47	16.70	49.00	57.90	19.75	34.10	15.55	691.00	6.65
M-044-1	6.62	1.22	3.71	1.68	0.00	0.00	18.47	56.10	25.43	0.00	0.00	8.37	17.40	48.80	58.30	20.80	35.70	14.50	630.00	6.90
M-044-2	6.42	1.18	4.18	1.06	0.00	0.00	18.35	65.04	16.54	0.00	0.07	8.58	17.10	50.10	58.40	19.90	34.10	14.70	661.00	6.60
M-044-3	6.52	1.20	3.95	1.37	0.00	0.00	18.41	60.57	20.99	0.00	0.04	8.48	17.25	49.45	58.35	20.35	34.90	14.60	645.50	6.75
L-026-1	4.98	1.05	3.54	0.39	0.00	0.00	21.02	71.08	7.90	0.00	0.00	8.52	16.70	48.60	57.00	19.60	34.40	14.90	727.00	6.90
L-026-2	4.90	1.15	3.07	0.67	0.00	0.00	23.51	62.71	13.77	0.00	0.00	8.50	17.00	49.00	57.60	20.00	34.70	14.60	661.00	6.70
L-026-3	4.94	1.10	3.31	0.53	0.00	0.00	22.27	66.90	10.84	0.00	0.00	8.51	16.85	48.80	57.30	19.80	34.55	14.75	694.00	6.80
H-066-1	6.26	1.04	4.36	0.86	0.00	0.00	16.57	69.67	13.74	0.02	0.00	8.35	16.50	48.40	58.00	19.80	34.10	14.80	743.00	6.60
H-066-2	6.58	1.27	3.85	1.45	0.01	0.00	19.37	58.45	22.03	0.08	0.07	8.22	17.50	47.80	58.10	21.30	36.60	14.50	667.00	6.60
H-066-3	6.42	1.16	4.11	1.16	0.01	0.00	17.97	64.06	17.89	0.05	0.04	8.29	17.00	48.10	58.05	20.55	35.35	14.65	705.00	6.60
C-006-1	7.12	1.15	5.44	0.54	0.00	0.00	16.09	76.40	7.52	0.00	0.00	8.42	16.00	50.20	59.60	19.00	31.90	14.40	674.00	6.30
C-006-2	7.40	1.13	5.49	0.75	0.02	0.01	15.23	74.16	10.17	0.25	0.19	8.47	16.70	50.10	59.10	19.70	33.30	13.90	667.00	6.20
C-006-3	7.26	1.14	5.47	0.65	0.01	0.01	15.66	75.28	8.85	0.13	0.10	8.45	16.35	50.15	59.35	19.35	32.60	14.15	670.50	6.25
M-046-1	6.68	1.36	4.45	0.87	0.01	0.00	20.35	66.59	12.96	0.10	0.00	8.40	15.60	49.60	59.10	18.60	31.50	14.40	701.00	7.30
M-046-2	6.88	1.44	4.49	0.95	0.00	0.00	20.87	65.29	13.77	0.07	0.00	8.36	16.90	50.10	59.90	20.20	33.70	14.60	716.00	7.20
M-046-3	6.78	1.40	4.47	0.91	0.01	0.00	20.61	65.94	13.37	0.09	0.00	8.38	16.25	49.85	59.50	19.40	32.60	14.50	708.50	7.25
L-028-1	6.54	1.51	4.51	0.50	0.03	0.00	23.04	68.92	7.65	0.39	0.00	7.80	15.20	45.50	58.30	19.50	33.40	14.10	654.00	6.70
L-028-2	6.32	1.34	4.19	0.79	0.00	0.00	21.20	66.29	12.52	0.00	0.00	7.60	14.90	44.50	58.60	19.60	33.50	13.80	696.00	6.60
L-028-3	6.43	1.43	4.35	0.65	0.02	0.00	22.12	67.61	10.09	0.20	0.00	7.70	15.05	45.00	58.45	19.55	33.45	13.95	675.00	6.65
H-068-1	4.10	0.69	3.09	0.32	0.00	0.00	16.82	75.45	7.73	0.00	0.00	8.36	16.30	48.90	58.50	19.50	33.30	14.00	628.00	7.10
H-068-2	4.12	0.62	3.20	0.29	0.00	0.00	15.03	77.76	7.09	0.02	0.00	8.42	16.60	49.80	59.10	19.70	33.30	14.60	569.00	6.60
H-068-3	4.11	0.66	3.15	0.31	0.00	0.00	15.93	76.61	7.41	0.06	0.00	8.39	16.45	49.35	58.80	19.60	33.30	14.30	598.50	6.85
C-008-1	4.54	0.78	3.54	0.22	0.00	0.00	17.15	77.99	4.83	0.03	0.00	7.25	14.20	41.80	57.70	19.60	34.00	14.50	589.00	6.80
C-008-2	4.40	0.75	3.45	0.20	0.01	0.00	16.97	78.38	4.52	0.14	0.00	7.29	13.30	42.20	57.90	18.20	31.50	14.20	733.00	7.10
C-008-3	4.47	0.77	3.50	0.21	0.01	0.00	17.06	78.19	4.68	0.09	0.00	7.27	13.75	42.00	57.80	18.90	32.75	14.35	661.00	6.95
M-048-1	7.32	1.41	5.39	0.51	0.00	0.00	19.26	73.66	7.02	0.00	0.06	8.48	16.90	49.40	58.30	19.90	34.20	14.40	625.00	7.10
M-048-2	6.96	1.43	4.99	0.53	0.01	0.00	20.52	71.66	7.67	0.14	0.00	8.56	16.80	49.90	58.30	19.60	33.70	14.30	603.00	6.90
M-048-3	7.14	1.42	5.19	0.52	0.01	0.00	19.89	72.66	7.35	0.07	0.03	8.52	16.85	49.65	58.30	19.75	33.95	14.35	614.00	7.00
L-030-1	5.84	1.00	4.38	0.45	0.00	0.00	17.16	75.01	7.75	0.08	0.00	8.70	15.80	51.00	58.60	18.20	31.00	15.00	712.00	7.00
L-030-2	5.84	1.07	4.24	0.52	0.00	0.00	18.40	72.64	8.87	0.00	0.08	8.47	16.20	49.00	57.90	19.10	33.10	14.70	699.00	6.60
L-030-3	5.84	1.04	4.31	0.49	0.00	0.00	17.78	73.83	8.31	0.04	0.04	8.59	16.00	50.00	58.25	18.65	32.05	14.85	705.50	6.80
H-070-1	7.06	1.65	5.00	0.41	0.00	0.00	23.32	70.80	5.87	0.00	0.00	8.31	16.00	48.10	57.90	19.30	33.30	14.20	688.00	6.80
H-070-2	7.02	1.51	5.05	0.45	0.00	0.00	21.58	71.94	6.42	0.07	0.00	8.57	16.60	49.50	57.80	19.40	33.50	14.50	698.00	6.90
H-070-3	7.04	1.58	5.03	0.43	0.00	0.00	22.45	71.37	6.15	0.04	0.00	8.44	16.30	48.80	57.85	19.35	33.40	14.35	693.00	6.85
C-010-1	6.32	0.99	4.78	0.54	0.01	0.00	15.64	75.61	8.52	0.17	0.05	8.32	16.30	47.80	57.50	19.60	34.10	14.30	664.00	6.80
C-010-2	6.32	0.91	5.07	0.33	0.00	0.00	14.46	80.16	5.23	0.07	0.07	8.30	16.60	48.10	58.00	20.00	34.50	14.20	651.00	7.20
C-010-3	6.32	0.95	4.93	0.44	0.01	0.00	15.05	77.89	6.88	0.12	0.06	8.31	16.45	47.95	57.75	19.80	34.30	14.25	657.50	7.00
M-050-1	5.16	0.78	4.11	0.26	0.02	0.00	15.07	79.61	5.01	0.31	0.00	6.87	12.40	40.20	58.50	18.00	30.80	13.60	140.00	7.90
M-050-2	3.46	0.80	2.56	0.09	0.01	0.01	23.02	74.01	2.57	0.26	0.15	5.18	14.60	29.70	57.30	28.20				

Sample ID	WBC	NE#	LY#	MO#	EO#	BA#	NE%	LY%	MO%	EO%	BA%	RBC	HB	HCT	MCV	MCH	MCHC	RDW	PLT	MPV
H-072-1	5.62	0.98	3.96	0.67	0.01	0.00	17.47	70.46	11.92	0.17	0.00	7.94	16.30	46.10	58.10	20.50	35.40	14.40	661.00	6.60
H-072-2	5.94	1.13	4.20	0.61	0.00	0.01	19.02	70.63	10.27	0.00	0.09	8.42	16.50	49.10	58.30	19.60	33.60	14.60	734.00	7.10
H-072-3	5.78	1.06	4.08	0.64	0.01	0.01	18.25	70.55	11.10	0.09	0.05	8.18	16.40	47.60	58.20	20.05	34.50	14.50	697.50	6.85
L-032-1	6.80	1.25	4.49	1.05	0.01	0.00	18.37	66.08	15.39	0.08	0.07	8.77	17.40	50.70	57.80	19.80	34.30	14.50	678.00	7.50
L-032-2	7.24	1.52	5.05	0.67	0.00	0.00	21.01	69.76	9.23	0.00	0.00	8.32	17.30	49.30	59.30	20.80	35.10	14.20	683.00	6.90
L-032-3	7.02	1.39	4.77	0.86	0.01	0.00	19.69	67.92	12.31	0.04	0.04	8.55	17.35	50.00	58.55	20.30	34.70	14.35	680.50	7.20
M-052-1	6.90	1.60	3.97	1.33	0.01	0.00	23.14	57.49	19.30	0.08	0.00	8.48	16.60	50.50	59.60	19.60	32.90	13.90	714.00	6.90
M-052-2	7.20	1.54	4.24	1.42	0.01	0.00	21.40	58.86	19.67	0.07	0.00	8.57	17.10	50.60	59.10	20.00	33.80	14.20	715.00	6.90
M-052-3	7.05	1.57	4.11	1.38	0.01	0.00	22.27	58.18	19.49	0.08	0.00	8.53	16.85	50.55	59.35	19.80	33.35	14.05	714.50	6.90
C-012-1	4.96	0.88	3.71	0.37	0.00	0.00	17.75	74.76	7.48	0.00	0.00	8.63	16.70	49.80	57.70	19.40	33.50	14.60	615.00	6.50
C-012-2	4.88	1.06	3.22	0.60	0.00	0.00	21.63	65.97	12.35	0.05	0.00	8.11	16.50	47.30	58.30	20.30	34.90	14.50	626.00	6.40
C-012-3	4.92	0.97	3.47	0.49	0.00	0.00	19.69	70.37	9.92	0.03	0.00	8.37	16.60	48.55	58.00	19.85	34.20	14.55	620.50	6.45
H-074-1	5.72	1.18	4.08	0.46	0.00	0.00	20.63	71.28	8.05	0.04	0.00	7.88	15.50	46.20	58.60	19.70	33.50	14.00	545.00	6.10
H-074-2	6.00	1.06	4.36	0.58	0.00	0.00	17.59	72.70	9.70	0.00	0.00	8.10	16.10	47.50	58.60	19.90	33.90	14.00	554.00	6.40
H-074-3	5.86	1.12	4.22	0.52	0.00	0.00	19.11	71.99	8.88	0.02	0.00	7.99	15.80	46.85	58.60	19.80	33.70	14.00	549.50	6.25
L-034-1	6.52	1.57	4.28	0.66	0.01	0.00	24.12	65.67	10.13	0.08	0.00	8.15	16.40	47.90	58.80	20.10	34.20	14.00	642.00	6.00
L-034-2	6.52	1.56	4.19	0.77	0.00	0.00	23.92	64.23	11.81	0.05	0.00	8.11	16.50	47.30	58.30	20.30	34.90	14.10	567.00	6.10
L-034-3	6.52	1.57	4.24	0.72	0.01	0.00	24.02	64.95	10.97	0.07	0.00	8.13	16.45	47.60	58.55	20.20	34.55	14.05	604.50	6.05
M-054-1	7.82	1.88	5.05	0.85	0.03	0.00	24.07	64.59	10.92	0.42	0.00	8.43	17.10	49.70	58.90	20.30	34.40	13.90	639.00	6.50
M-054-2	7.86	2.08	4.82	0.92	0.04	0.00	26.46	61.34	11.67	0.52	0.00	8.32	17.30	49.30	59.20	20.80	35.10	14.20	657.00	6.10
M-054-3	7.84	1.98	4.94	0.89	0.04	0.00	25.27	62.97	11.30	0.47	0.00	8.38	17.20	49.50	59.05	20.55	34.75	14.05	648.00	6.30
C-014-1	6.14	0.97	4.69	0.49	0.00	0.00	15.75	76.32	7.91	0.02	0.00	7.97	16.70	46.90	58.90	21.00	35.60	14.20	659.00	6.40
C-014-2	5.84	0.97	4.34	0.53	0.00	0.00	16.60	74.31	9.01	0.08	0.00	8.11	15.70	48.00	59.20	19.40	32.70	14.00	678.00	6.60
C-014-3	5.99	0.97	4.52	0.51	0.00	0.00	16.18	75.32	8.46	0.05	0.00	8.04	16.20	47.45	59.05	20.20	34.15	14.10	668.50	6.50
H-076-1	6.20	0.99	4.65	0.56	0.00	0.00	16.01	74.94	8.98	0.00	0.07	8.56	17.60	50.10	58.50	20.60	35.10	14.00	690.00	6.70
H-076-2	6.20	0.85	4.98	0.37	0.00	0.00	13.75	80.30	5.91	0.04	0.00	8.61	16.80	50.60	58.80	19.50	33.20	14.20	597.00	6.20
H-076-3	6.20	0.92	4.82	0.47	0.00	0.00	14.88	77.62	7.45	0.02	0.04	8.59	17.20	50.35	58.65	20.05	34.15	14.10	643.50	6.45
L-036-1	5.04	1.26	3.47	0.30	0.01	0.00	25.01	68.92	5.87	0.19	0.00	5.85	10.80	33.40	57.10	18.50	32.30	13.60	506.00	6.50
L-036-2	7.60	1.79	5.34	0.47	0.00	0.00	23.49	70.32	6.17	0.03	0.00	8.62	16.70	51.10	59.30	19.40	32.70	14.20	620.00	6.20
L-036-3	6.32	1.53	4.41	0.39	0.01	0.00	24.25	69.62	6.02	0.11	0.00	7.24	13.75	42.25	58.20	18.95	32.50	13.90	563.00	6.35
M-056-1	6.54	1.56	4.48	0.50	0.00	0.00	23.78	68.55	7.66	0.02	0.00	7.88	15.80	46.10	58.50	20.10	34.30	14.70	574.00	6.70
M-056-2	6.68	1.67	4.53	0.46	0.02	0.00	25.05	67.77	6.84	0.26	0.07	8.03	16.00	47.00	58.50	19.90	34.00	14.70	493.00	6.40
M-056-3	6.61	1.62	4.51	0.48	0.01	0.00	24.42	68.16	7.25	0.14	0.04	7.96	15.90	46.55	58.50	20.00	34.15	14.70	533.50	6.55
C-016-1	6.38	1.00	5.10	0.28	0.00	0.00	15.68	79.91	4.41	0.00	0.00	8.15	15.60	47.90	58.80	19.10	32.60	14.00	647.00	6.20
C-016-2	6.30	1.22	4.56	0.51	0.01	0.00	19.40	72.37	8.02	0.21	0.00	7.94	16.10	46.20	58.20	20.30	34.80	14.00	630.00	6.30
C-016-3	6.34	1.11	4.83	0.40	0.01	0.00	17.54	76.14	6.22	0.11	0.00	8.05	15.85	47.05	58.50	19.70	33.70	14.00	638.50	6.25
H-078-1	3.28	0.68	2.48	0.12	0.00	0.00	20.74	75.55	3.58	0.14	0.00	6.31	11.70	36.50	57.90	18.50	32.10	13.80	597.00	6.60
H-078-2	4.06	0.87	2.95	0.24	0.00	0.00	21.47	72.68	5.86	0.00	0.00	7.88	15.30	46.50	59.00	19.40	32.90	13.90	581.00	6.30
H-078-3	3.67	0.78	2.72	0.18	0.00	0.00	21.11	74.12	4.72	0.07	0.00	7.10	13.50	41.50	58.45	18.95	32.50	13.85	589.00	6.45
L-038-1	6.00	1.23	4.33	0.44	0.00	0.00	20.53	72.12	7.28	0.00	0.08	8.35	15.60	48.80	58.50	18.70	32.00	14.10	603.00	6.30
L-038-2	6.18	1.18	4.68	0.31	0.01	0.00	19.13	75.65	5.02	0.20	0.00	8.19	16.10	47.70	58.20	19.70	33.80	13.80	655.00	6.90
L-038-3	6.09	1.21	4.51	0.38	0.01	0.00	19.83	73.89	6.15	0.10	0.04	8.27	15.85	48.25	58.35	19.20	32.90	13.95	629.00	6.60
M-058-1	4.80	1.17	3.19	0.43	0.01	0.00	24.39	66.45	8.87	0.28	0.00	8.35	16.20	48.70	58.30	19.40	33.30	14.80	620.00	6.40
M-058-2	4.92	1.07	3.35	0.48	0.02	0.00	21.82	68.15	9.72	0.31	0.00	7.90	15.40	46.10	58.40	19.50	33.40	14.30	638.00	6.50
M-058-3	4.86	1.12	3.27	0.46	0.02	0.00	23.11	67.30	9.30	0.30	0.00	8.13	15.80	47.40	58.35	19.45	33.35	14.55	629.00	6.45
C-018-1	6.24	1.07	4.63	0.53	0.00	0.00	17.22	74.25	8.53	0.00	0.00	8.41	16.10	49.10	58.40	19.10	32.80	14.80	699.00	6.70
C-018-2	6.52	1.18	4.61	0.71	0.02	0.00	18.13	70.63	10.88	0.28	0.07	8.67	16.10	50.60	58.40	18.60	31.80	14.70	648.00	6.60
C-018-3	6.38	1.13	4.62	0.62	0.01	0.00	17.68	72.44	9.71	0.14	0.04	8.54	16.10	49.85	58.40	18.85	32.30	14.75	673.50	6.65
H-080-1	6.36	1.12	4.73	0.51	0.00	0.00	17.64	74.40	7.96	0.00	0.00	8.70	16.70	51.20	58.80	19.20	32.60	13.90	686.00	6.50
H-080-2	6.62	1.01	4.84	0.77	0.00	0.00	15.33	73.04	11.63	0.00	0.00	8.86	16.90	52.30	59.00	19.10	32.30	13.90	689.00	6.60
H-080-3	6.49	1.07	4.79	0.64	0.00	0.00	16.49	73.72	9.80	0.00	0.00	8.78	16.80	51.75	58.90	19.15	32.45	13.90	687.50	6.55
L-040-1	7.42	1.07	5.89	0.46	0.00	0.00	14.42	79.42	6.15	0.00	0.00	8.28	16.70	48.60	58.70	20.20	34.40	14.70	676.00	7.00
L-040-2	7.28	0.90	5.68	0.69	0.01	0.00	12.43	78.07	9.41	0.08	0.00	7.09	15.50	41.40	58.40	21.90	37.40	13.80	637.00	7.10
L-040-3	7.35	0.99	5.79	0.58	0.01	0.00	13.43	78.75	7.78	0.04	0.00	7.69	16.10	45.00	58.55	21.05	35.90	14.25	656.50	7.05
M-060-1	5.90	0.81	4.60	0.47	0.02	0.00	13.72	77.91	8.05	0.31	0.00	8.75	17.50	51.70	59.10	20.00	33.80	14.20	731.00	6.50
M-060-2	5.68	0.79	4.53	0.35	0.00	0.00	13.99	79.84	6.08	0.08	0.00	8.68	16.80	51.00	58.80	19.40	32.90	14.60	677.00	6.50
M-060-3	5.79	0.80	4.57	0.41	0.01	0.00	13.86	78.88	7.07	0.20	0.00	8.72	17.15	51.35	58.95	19.70	33.35	14.40	704.00	6.50
C-020-1	5.20	1.08	3.68	0.41	0.02	0.01	20.85	70.72	7.92	0.29	0.22	8.37	16.20	49.20	58.80	19.40	32.90	14.00	596.00	6.90
C-020-2	5.12	1.03	3.77	0.28	0.01	0.03	20.02	73.72	5.45	0.21	0.60	8.74	16.80	51.00	58.40	19.20	32.90	14.00	502.00	7.10
C-020-3	5.16	1.06	3.73																	

APPENDIX J. MEASUREMENT OF α_2 -GLOBULIN PROTEIN IN KIDNEY SAMPLES

α_2 -Globulin Protein Data in Male Rats following Exposure to Gevo (bio) ATJ SPK

Animal ID	Group	Total protein concentration (ug/ml)	Total protein concentration (mg/ml)	Total protein concentration (ng/ml)	Initial Dilution Factor	Second Dilution Factor (males to 78, females to 12400)	ELISA result (ng/ml)	Adjusted ELISA result (ng/ml)	Adjusted ELISA result (ug/ml)	ng A2U/ng Total protein	ug A2U/mg Total protein
1	Control	33567.61	33.568	33567610	1000	430.354	3.908	1681823.332	1681.823332	0.050102564	50.103
3	Control	32434.27	32.434	32434270	1000	415.824	3.772	1568488.031	1568.488031	0.048358974	48.359
5	Control	39808.41	39.808	39808405	1000	510.364	2.768	1412688.013	1412.688013	0.035487179	35.487
7	Control	34715.80	34.716	34715798	1000	445.074	2.994	1332552.554	1332.552554	0.038384615	38.385
109	Control	32028.45	32.028	32028445	1000	410.621	2.408	988775.5841	988.7755841	0.030871795	30.872
11	Control	28267.14	28.267	28267142	1000	362.399	2.108	763937.6325	763.9376325	0.027025641	27.026
13	Control	33552.76	33.553	33552763	1000	430.164	2.393	1029381.562	1029.381562	0.030679487	30.679
15	Control	37229.93	37.230	37229932	1000	477.307	1.755	837673.47	837.67347	0.0225	22.500
117	Control	39798.51	39.799	39798507	1000	510.237	2.091	1066906.13	1066.90613	0.026807692	26.808
19	Control	31954.21	31.954	31954209	1000	409.669	1.869	765672.008	765.672008	0.023961538	23.962
21	Low	31785.94	31.786	31785940	1000	407.512	4.99	2033485.136	2033.485136	0.063974359	63.974
23	Low	36309.40	36.309	36309403	1000	465.505	2.338	1088351.08	1088.35108	0.029974359	29.974
25	Low	32191.77	32.192	32191765	1000	412.715	4.218	1740831.6	1740.8316	0.054076923	54.077
27	Low	32736.16	32.736	32736164	1000	419.694	3.476	1458857.77	1458.85777	0.044564103	44.564
129	Low	32379.83	32.380	32379830	1000	415.126	2.233	926976.4153	926.9764153	0.028628205	28.628
31	Low	32854.94	32.855	32854942	1000	421.217	2.471	1040827.714	1040.827714	0.031679487	31.679
33	Low	38021.79	38.022	38021786	1000	487.459	2.697	1314676.37	1314.67637	0.034576923	34.577
35	Low	35086.98	35.087	35086979	1000	449.833	3.044	1369291.847	1369.291847	0.039025641	39.026
37	Low	36507.37	36.507	36507366	1000	468.043	1.687	789588.8005	789.5888005	0.021628205	21.628
39	Low	31013.88	31.014	31013883	1000	397.614	3.497	1390455.755	1390.455755	0.044833333	44.833
41	Medium	24774.36	24.774	24774358	1000	317.620	5.164	1640189.548	1640.189548	0.066205128	66.205
43	Medium	27502.22	27.502	27502223	1000	352.593	4.392	1548586.71	1548.58671	0.056307692	56.308
45	Medium	32592.54	32.593	32592539	1000	417.853	3.179	1328354.891	1328.354891	0.04075641	40.756
47	Medium	26321.00	26.321	26320998	1000	337.449	4.483	1512782.488	1512.782488	0.057474359	57.474
49	Medium	25377.72	25.378	25377717	1000	325.355	4.402	1432214.234	1432.214234	0.056435897	56.436
51	Medium	24701.25	24.701	24701247	1000	316.683	3.4	1076721.001	1076.721001	0.043589744	43.590
53	Medium	26805.39	26.805	26805385	1000	343.659	5.283	1815549.346	1815.549346	0.067730769	67.731
55	Medium	34372.88	34.373	34372875	1000	440.678	3.468	1528270.904	1528.270904	0.044461538	44.462
57	Medium	26686.41	26.686	26686413	1000	342.134	3.29	1125619.215	1125.619215	0.042179487	42.179
59	Medium	27281.28	27.281	27281275	1000	349.760	2.626	918469.5917	918.4695917	0.033666667	33.667
61	High	32295.11	32.295	32295109	1000	414.040	4.069	1684728.186	1684.728186	0.052166667	52.167
63	High	31555.78	31.556	31555780	1000	404.561	4.929	1994082.559	1994.082559	0.063192308	63.192
65	High	35932.26	35.932	35932263	1000	460.670	4.488	2067487.133	2067.487133	0.057538462	57.538
135	High	34708.55	34.709	34708547	1000	444.981	3.862	1718518.058	1718.518058	0.049512821	49.513
69	High	25003.80	25.004	25003804	1000	320.562	6.312	2023384.754	2023.384754	0.080923077	80.923
71	High	35477.62	35.478	35477618	1000	454.841	2.592	1178948.537	1178.948537	0.033230769	33.231
73	High	32112.40	32.112	32112401	1000	411.697	3.313	1363953.648	1363.953648	0.042474359	42.474
75	High	27013.59	27.014	27013587	1000	346.328	3.456	1196909.701	1196.909701	0.044307692	44.308
77	High	33115.17	33.115	33115168	1000	424.553	2.988	1268565.666	1268.565666	0.038307692	38.308
79	High	31797.97	31.798	31797974	1000	407.666	4.548	1854066.484	1854.066484	0.058307692	58.308

Note: Control = 0 mg/m³ Gevo (bio); Low = 200 mg/m³ Gevo (bio); Medium = 700 mg/m³ Gevo (bio); High = 1500 mg/m³ Gevo (bio)

α_2 -Globulin Protein Data in Female Rats following Exposure to Gevo (bio) ATJ SPK

Animal ID	Group	Total protein concentration (ug/ml)	Total protein concentration (mg/ml)	Total protein concentration (ng/ml)	Initial Dilution Factor	Second Dilution Factor (males to 78, females to 12400)	ELISA result (ng/ml)	Adjusted ELISA result (ng/ml)	Adjusted ELISA result (ug/ml)	ng A2U/ng Total protein	ug A2U/mg Total protein
2	Control	29247.06	29.247	29247060	1000	2.359	3.773	8899.125595	8.899125595	0.000304274	0.304
4	Control	35542.30	35.542	35542295	1000	2.866	2.427	6956.544352	6.956544352	0.000195726	0.196
6	Control	31573.13	31.573	31573130	1000	2.546	3.485	8873.577262	8.873577262	0.000281048	0.281
8	Control	34720.75	34.721	34720747	1000	2.800	1.024	2867.261688	2.867261688	8.25806E-05	0.083
10	Control	30261.62	30.262	30261623	1000	2.440	1.887	4605.135694	4.605135694	0.000152177	0.152
12	Control	26718.08	26.718	26718079	1000	2.155	1.262	2719.210943	2.719210943	0.000101774	0.102
14	Control	27331.77	27.332	27331765	1000	2.204	1.934	4262.87367	4.26287367	0.000155968	0.156
16	Control	33879.40	33.879	33879403	1000	2.732	1.315	3592.856044	3.592856044	0.000106048	0.106
18	Control	30380.40	30.380	30380401	1000	2.450	1.278	3131.141329	3.131141329	0.000103065	0.103
20	Control	27000.18	27.000	27000177	1000	2.177	2.247	4892.693364	4.892693364	0.00018121	0.181
22	Low	30791.18	30.791	30791175	1000	2.483	2.762	6858.485915	6.858485915	0.000222742	0.223
24	Low	35760.05	35.760	35760054	1000	2.884	1.797	5182.323955	5.182323955	0.000144919	0.145
26	Low	27495.09	27.495	27495085	1000	2.217	4.971	11022.4248	11.0224248	0.000400887	0.401
28	Low	31345.47	31.345	31345472	1000	2.528	2.333	5897.498885	5.897498885	0.000188145	0.188
30	Low	29331.20	29.331	29331195	1000	2.365	1.183	2798.29062	2.79829062	9.54032E-05	0.095
32	Low	30197.28	30.197	30197284	1000	2.435	2.556	6224.536928	6.224536928	0.000206129	0.206
34	Low	39595.59	39.596	39595594	1000	3.193	1.386	4425.765587	4.425765587	0.000111774	0.112
36	Low	35161.22	35.161	35161215	1000	2.836	1.395	3955.636688	3.955636688	0.0001125	0.113
38	Low	32063.09	32.063	32063089	1000	2.586	0.845	2184.944371	2.184944371	6.81452E-05	0.068
40	Low	41476.25	41.476	41476246	1000	3.345	0.779	2605.644809	2.605644809	6.28226E-05	0.063
42	Medium	22348.17	22.348	22348172	1000	1.802	7.348	13243.09418	13.24309418	0.000592581	0.593
44	Medium	26074.56	26.075	26074555	1000	2.103	4.999	10511.83068	10.51183068	0.000403145	0.403
46	Medium	25101.53	25.102	25101532	1000	2.024	3.992	8081.07385	8.08107385	0.000321935	0.322
48	Medium	24553.41	24.553	24553409	1000	1.980	2.445	4841.377823	4.841377823	0.000197177	0.197
50	Medium	25016.55	25.017	25016551	1000	2.017	8.823	17800.08302	17.80008302	0.000711532	0.712
52	Medium	23911.81	23.912	23911808	1000	1.928	2.111	4070.792475	4.070792475	0.000170242	0.170
54	Medium	25836.61	25.837	25836611	1000	2.084	1.615	3365.010223	3.365010223	0.000130242	0.130
56	Medium	23074.75	23.075	23074753	1000	1.861	1.485	2763.387758	2.763387758	0.000119758	0.120
58	Medium	28186.31	28.186	28186314	1000	2.273	1.534	3486.919813	3.486919813	0.00012371	0.124
60	Medium	30166.35	30.166	30166354	1000	2.433	0.984	2393.846156	2.393846156	7.93548E-05	0.079
62	High	29350.54	29.351	29350543	1000	2.367	2.45	5799.099222	5.799099222	0.000197581	0.198
64	High	27038.59	27.039	27038587	1000	2.181	1.958	4269.480109	4.269480109	0.000157903	0.158
66	High	26648.17	26.648	26648172	1000	2.149	3.649	7841.869325	7.841869325	0.000294274	0.294
68	High	26185.03	26.185	26185030	1000	2.112	2.603	5496.744604	5.496744604	0.000209919	0.210
70	High	25666.65	25.667	25666650	1000	2.070	0.85	1759.40746	1.75940746	6.85484E-05	0.069
72	High	24765.86	24.766	24765860	1000	1.997	2.568	5128.929716	5.128929716	0.000207097	0.207
74	High	33659.04	33.659	33659041	1000	2.714	1.26	3420.192876	3.420192876	0.000101613	0.102
76	High	28674.82	28.675	28674820	1000	2.312	0.998	2307.860513	2.307860513	8.04839E-05	0.080
78	High	28483.75	28.484	28483745	1000	2.297	4.87	11186.76114	11.18676114	0.000392742	0.393
80	High	31989.18	31.989	31989180	1000	2.580	6.251	16126.1584	16.1261584	0.000504113	0.504

Note: Control = 0 mg/m³ Gevo (bio); Low = 200 mg/m³ Gevo (bio); Medium = 700 mg/m³ Gevo (bio); High = 1500 mg/m³ Gevo (bio)

APPENDIX K. BONE MARROW MICRONUCLEI GENOTOXICITY ASSAY DATA

Male Rat Micronucleus Results

Female Rat Micronucleus Results

Animal ID	Exposure Group	% RET	% MN-RET	Animal ID	Group	% RET	%MN-RET
121	VC	27.91	0.08	122	VC	25.08	0.1
123	VC	17.9	0.12	124	VC	33.52	0.06
125	VC	24.74	0.11	126	VC	23.29	0.08
127	VC	35.31	0.07	128	VC	27.69	0.09
29	VC	34.33	0.12	130	VC	34.54	0.07
131	PC	13.59	0.67	132	PC	10.55	0.49
133	PC	25.61	1.98	134	PC	15.69	0.54
67	PC	28.84	0.82	136	PC	17.15	0.53
137	PC	12.32	0.55	138	PC	4.43	0.41
139	PC	13.76	0.53	140	PC	2.58	0.34
Animal ID	Exposure Group	% RET	% MN-RET	Animal ID	Group	% RET	%MN-RET
81	C	22.37	0.07	82	C	27.78	0.09
83	C	9.02	0.05	84	C	11.48	0.04
85	C	19.95	0.07	86	C	20.27	0.07
87	C	16.73	0.13	88	C	15.29	0.06
89	C	15.36	0.10	90	C	13.48	0.07
91	L	20.62	0.06	92	L	16.77	0.04
93	L	17.66	0.04	94	L	13.71	0.05
95	L	11.21	0.04	96	L	22.11	0.03
97	L	19.72	0.03	98	L	17.41	0.03
99	L	19.12	0.06	100	L	32.56	0.03
101	M	19.72	0.09	102	M	22.65	0.11
103	M	23.57	0.02	104	M	22.5	0.04
105	M	29.21	0.05	106	M	20.88	0.09
107	M	24.22	0.05	108	M	9.04	0.07
109	M	42.44	0.03	110	M	27.38	0.02
111	H	20.03	0.03	112	H	30.43	0.01
113	H	7.61	0	114	H	19.4	0.02
115	H	16.67	0.02	116	H	19.31	0.05
117	H	20.9	0.01	118	H	31.12	0.01
119	H	18.8	0.03	120	H	29.42	0.03

Note: PC = positive control; VC = vehicle control; C = control (0 mg/m³ Gevo (bio)); L = 200 mg/m³ Gevo (bio); M = 700 mg/m³ Gevo (bio); H = 1500 mg/m³ Gevo (bio); MN-RET = micronucleated reticulocytes; RET = reticulocytes

LIST OF ACRONYMS

α_2 -globulin	alpha-2-urinary globulin
AAALAC	Association for Assessment and Accreditation of Laboratory Animal Care
AFB	Air Force Base
ANOVA	analysis of variance
APS	aerodynamic particle sizer
ATJ	alcohol to jet
AVMA	American Veterinary Medical Association
bio	biologically-derived
CASA	computer assisted sperm analysis
CP	cyclophosphamide
CPG	chronic progressive glomerulonephropathy
DOD	Department of Defense
DTIC	Defense Technical Information Center
ELISA	enzyme-linked immunosorbent assay
EPA	Environmental Protection Agency
FOB	functional observational battery
FT	Fischer-Tropsch
FTIR	Fourier transform infrared
GC	gas chromatography
GLP	Good Laboratory Practices
GSD	geometric standard deviation
HEFA	hydroprocessed esters and fatty acids
HEFA F	HEFA-Animal fats and oils
HEFA-C	HEFA-Camelina
HEFA-T	HEFA-Tallow
HEPA	high efficiency particulate air
HJF	Henry M. Jackson Foundation for the Advancement of Military Medicine
IACUC	Installation Animal Care and Use Committee
INR	international normalized ratio
MMAD	mass median aerodynamic diameter
NAMRU-D	Naval Medical Research Unit – Dayton
OECD	Organisation for Economic Cooperation and Development
OPPTS	Office of Prevention, Pesticides and Toxic Substances
PT-P	prothrombin time in plasma
SD	standard deviation
SPK	synthetic paraffinic kerosene
USAF	U.S. Air Force
WBC	white blood cell